# APPENDIX – A123.2

## Methodology of Preliminary Design for Distribution Network Mains

## A123.2 Methodology of Preliminary Design for Distribution Network Mains

### (1) Method of Estimating the Required Distribution Network Mains

The priority project area includes North Nazimabad, Gulberg, Liaquatabad which are consists of 29 UCs in total. To estimate the required capacities and lengths of the distribution network mains (12 inch or less in diameter) in these three towns, 27 residential UCs out of the 29 UCs were grouped into five residential area groups as shown in **Figure A123.2.1** with different colours, based on the observed differences in average plot size and density of road network and on towns to which they belong to. The other two UCs located in Gulberg were recognized as industrial areas. From each residential area group, one representative UC was chosen as a sample design area for the preliminary design of distribution network mains to analyse the required capacities and lengths of new distribution network mains. The extent of designed new distribution network mains in the five sample design areas of residential use and in the two industrial areas are shown as red pipelines in **Figure A123.2.1.**

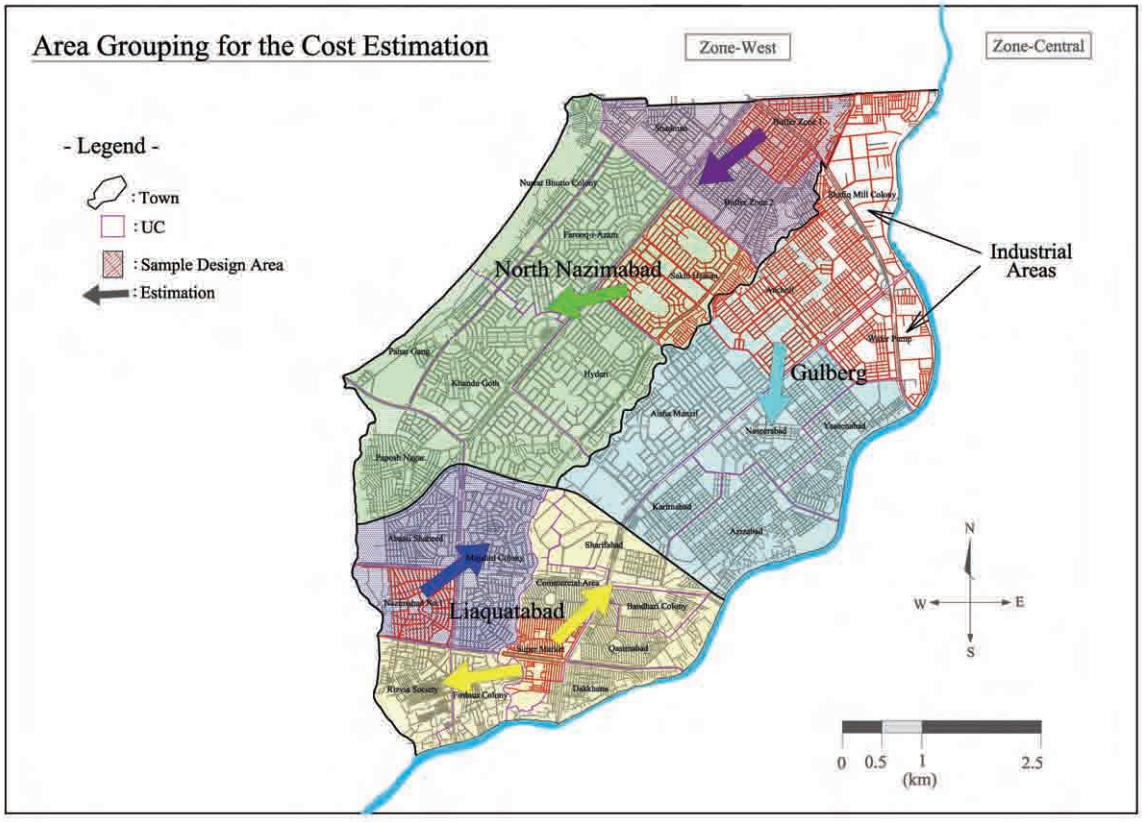



**Figure A123.2.1 Area Grouping for the Preliminary Design of Distribution Network**

The results of the hydraulic analysis in each sample design area were used to estimate the required total length of distribution network mains in the other UCs within the same residential area group as illustrated in **Figure A123.2.1** and **Table A123.2.1** with the corresponding colours. Since the average construction cost of distribution network mains with different diameters per meter was calculated in each sample design area based on the diameter-wise required total lengths of distribution network mains analysed for each sample design area, only the estimation of total length of all the distribution network mains were required for each of the other residential UCs for cost estimation. The estimation of the total required pipe lengths in other residential UCs were conducted based on the assumptions that the relations of the population and area of each UC to its required length of distribution network mains are proportional within each residential area group. In other words, the required pipe lengths in the five sample design

areas were used to estimate the required pipe lengths in the remaining 22 residential UCs. The required distribution network mains in the two industrial UCs were also analysed.

**Table A123.2.1 UC-wise Length Estimation of Distribution Network Mains**

| | Town/UC | Population in 2016 | Area (ha) | Estimated Pipeline Length (m) |
|---|---|---|---|---|
| Priority Project Area | | 2,755,756 | 4,270 | 1,062,020 |
| North Nazimabad | | 907,352 | 1,716.1 | 353,241 |
| 1 | Paposh Nagar | 126,736 | 142.3 | 32,772 |
| 2 | Pahar Gang | 77,313 | 110.0 | 15,446 |
| 3 | Khandu Goth | 96,299 | 289.9 | 50,713 |
| 4 | Hyderi | 106,758 | 212.0 | 41,126 |
| 5 | Sakhi Hassan | 108,474 | 212.5 | **41,881** |
| 6 | Farooq-e-Azam | 72,115 | 215.5 | 28,239 |
| 7 | Nusrat Bhutto Colony | 71,313 | 136.7 | 17,708 |
| 8 | Shadman | 69,480 | 136.0 | 35,463 |
| 9 | Buffer Zone 2 | 105,684 | 148.9 | 59,063 |
| 10 | Buffer Zone 1 | 73,180 | 112.3 | **30,831** |
| Gulberg | | 829,262 | 1,428.0 | 391,042 |
| 1 | Azizabad | 124,095 | 190.9 | 68,098 |
| 2 | Karimabad | 81,456 | 77.1 | 18,052 |
| 3 | Aisha Manzil | 114,073 | 268.0 | 87,850 |
| 4 | Ancholi | 116,281 | 195.8 | **65,451** |
| 5 | Naseerabad | 127,204 | 126.0 | 46,079 |
| 6 | Yaseenabad | 87,116 | 163.4 | 40,921 |
| 7 | Water Pump | 78,759 | 145.5 | **21,823** |
| 8 | Shafiq Mill Colony | 100,278 | 261.2 | **42,769** |
| Liaquatabad | | 1,019,142 | 1,126.1 | 317,737 |
| 1 | Rizvia Society | 98,431 | 112.2 | 36,883 |
| 2 | Firdous Colony | 95,772 | 85.0 | 27,182 |
| 3 | Super Market | 81,759 | 74.0 | **20,218** |
| 4 | Dak Khane | 85,699 | 77.5 | 22,179 |
| 5 | Qasimabad | 104,907 | 102.3 | 35,851 |
| 6 | Bandhani Colony | 84,276 | 56.5 | 15,907 |
| 7 | Sharif Abad | 95,139 | 115.6 | 36,749 |
| 8 | Commercial Area | 98,077 | 90.2 | 29,551 |
| 9 | Mujiahid Colony | 105,189 | 198.7 | 49,819 |
| 10 | Nazimabad No.1 | 83,167 | 103.4 | **20,495** |
| 11 | Abbasi Shaheed | 86,726 | 110.8 | 22,904 |

### (2) Method of UC-wise Network Analysis and Water Supply Blocks

Hydraulic equations and programs used for the hydraulic analysis of distribution network mains are basically as same as those used for the hydraulic analysis of transmission mains and trunk distribution mains for the preparation of Water Supply Master Plan as explained in **Section 7.7** of the Main Report The following shows the method and conditions used especially for the analysis of distribution network mains (12 inch or less in pipe diameter).

In the preliminary design of distribution network mains in the sample design areas, several water supply blocks were designed for each UC, as **Figure A123.2.2** shows its example, through UC-wise network analysis. Each water supply blocks should be connected to nearby trunk distribution mains and/or nearby water supply blocks at several points. Each water supply block should be hydraulically isolatable by closing block valves installed between water supply blocks and/or at the connection points with distribution trunk mains. Sub-district meters will be installed as well as block valves at the same points to estimate water leakage in each water supply block. The extent of each water supply block was set within about a 1.5-km diameter for facilitating the pipe maintenance work required in the future.

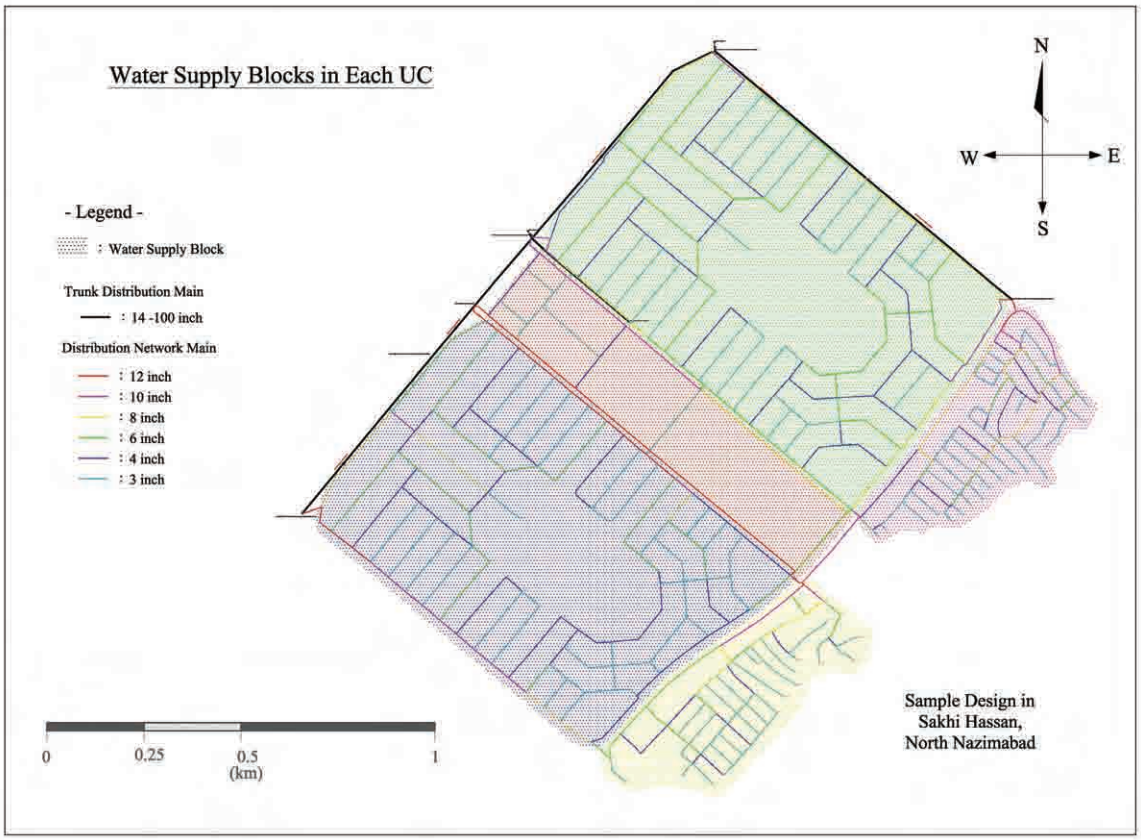



**Figure A123.2.2 Water Supply Blocks in Each UC**

All the households within the area should be geographically accessible to the network without significant difficulty. The pipe aliment was designed, based on the width of the road under which the pipe will be installed, by visually recognizing it on the satellite imagery as shown in **Figure A123.2.3** as a sample hydraulic network model. As principle, pipes will be installed in the centre of road if the road is relatively narrow while they will be installed at the side if the road is wide.

**Tables A123.2.2** and **A123.2.3** shows the results of the sample hydraulic analysis that correspond the network model for the water supply block shown in **Figure A123.2.3**. Prior to the hydraulic analysis of distribution network mains, the trunk distribution mains required for the priority project was planned and analysed hydraulically. The analysis results of trunk distribution mains showed that water can be delivered to most of the UCs within the priority project area at a remaining pressure of more than 15 m in water head (the pressure before entering the distribution network mains of 12 inch or less). Therefore, in the analysis of distribution network mains, the pressure of all the connection points with trunk distribution mains were set at a assumed value of 15m for the simplification of the network analysis. Through the hydraulic analysis of distribution network, all the required distribution mains were designed to have a residual pressure of more than 10m. As shown in **Table A123.2.2**, the C-value (Hazen-Williams Coefficient) of the PE pipe recommended as distribution network mains was set at 140.

Since the difference in height within each UC in the priority project area is only few meter in most of the UCs, it was assumed for the simplification of model analysis that the height of each junction of distribution network mains within a UC is the same as shown in **Table 123.2.3**. In the modelling, the water demand in 2016 in each UC was allocated to each pipe junction equally as seen in **Table 123.2.3** after being multiplied by an hourly peak factor of 1.5.


**Figure A123.2.3 Example of Distribution Network Analysis for Each Water Supply Block**

**Table A123.2.2 Results of the Sample Network Analysis (Pipes) 1/3**

| Pipe ID | Length (m) | Diameter (in) | Material | Hazen-Williams C | Velocity (m/s) | Discharge (gal(Imp)/d) | Pressure Pipe Headloss (m) | Headloss Gradient (m/km) |
|---|---|---|---|---|---|---|---|---|
| P-2202 | 7.32 | 12 | PE | 140 | 0.31 | 433,510 | 0.00 | 0.34 |
| P-2203 | 38.10 | 10 | PE | 140 | 0.31 | 294,555 | 0.02 | 0.40 |
| P-2204 | 69.19 | 10 | PE | 140 | 0.18 | 176,210 | 0.01 | 0.15 |
| P-2205 | 61.26 | 8 | PE | 140 | 0.20 | 120,841 | 0.01 | 0.23 |
| P-2206 | 58.83 | 6 | PE | 140 | 0.25 | 85,715 | 0.03 | 0.49 |
| P-2207 | 57.61 | 6 | PE | 140 | 0.15 | 52,519 | 0.01 | 0.20 |
| P-2208 | 56.39 | 6 | PE | 140 | 0.06 | 20,200 | 0.00 | 0.03 |
| P-2209 | 57.00 | 6 | PE | 140 | 0.03 | 11,951 | 0.00 | 0.01 |
| P-2210 | 58.22 | 6 | PE | 140 | 0.31 | 108,916 | 0.04 | 0.76 |
| P-2211 | 58.52 | 8 | PE | 140 | 0.29 | 180,109 | 0.03 | 0.48 |
| P-2212 | 55.47 | 8 | PE | 140 | 0.43 | 263,553 | 0.05 | 0.96 |
| P-2213 | 60.05 | 8 | PE | 140 | 0.35 | 216,149 | 0.04 | 0.67 |
| P-2214 | 55.47 | 8 | PE | 140 | 0.25 | 153,453 | 0.02 | 0.35 |
| P-2215 | 60.35 | 8 | PE | 140 | 0.10 | 61,460 | 0.00 | 0.06 |
| P-2216 | 57.30 | 8 | PE | 140 | 0.02 | 13,382 | 0.00 | 0.00 |
| P-2217 | 179.83 | 8 | PE | 140 | 0.28 | 175,352 | 0.08 | 0.45 |
| P-2218 | 33.22 | 12 | PE | 140 | 0.55 | 768,229 | 0.03 | 0.97 |
| P-2221 | 5.18 | 12 | PE | 140 | 0.36 | 493,275 | 0.00 | 0.43 |
| P-2222 | 196.29 | 10 | PE | 140 | 0.60 | 574,187 | 0.27 | 1.37 |
| P-2223 | 60.35 | 10 | PE | 140 | 0.48 | 466,422 | 0.06 | 0.93 |
| P-2224 | 150.88 | 8 | PE | 140 | 0.61 | 378,083 | 0.28 | 1.88 |
| P-2225 | 64.01 | 8 | PE | 140 | 0.54 | 335,574 | 0.10 | 1.51 |
| P-2226 | 59.44 | 8 | PE | 140 | 0.39 | 242,824 | 0.05 | 0.83 |
| P-2227 | 143.56 | 8 | PE | 140 | 0.32 | 195,715 | 0.08 | 0.55 |
| P-2228 | 166.12 | 6 | PE | 140 | 0.10 | 34,719 | 0.02 | 0.09 |
| P-2229 | 61.87 | 6 | PE | 140 | 0.14 | 48,952 | 0.01 | 0.17 |
| P-2230 | 57.00 | 6 | PE | 140 | 0.20 | 70,402 | 0.02 | 0.34 |
| P-2231 | 57.30 | 6 | PE | 140 | 0.28 | 98,110 | 0.04 | 0.63 |
| P-2232 | 57.30 | 6 | PE | 140 | 0.41 | 143,155 | 0.07 | 1.26 |
| P-2233 | 57.00 | 6 | PE | 140 | 0.52 | 180,556 | 0.11 | 1.94 |
| P-2235 | 56.08 | 6 | PE | 140 | 0.30 | 105,522 | 0.04 | 0.72 |
| P-2236 | 59.44 | 6 | PE | 140 | 0.46 | 159,936 | 0.09 | 1.55 |
| P-2237 | 55.47 | 6 | PE | 140 | 0.39 | 135,977 | 0.06 | 1.15 |
| P-2238 | 59.13 | 8 | PE | 140 | 0.26 | 160,366 | 0.02 | 0.38 |
| P-2239 | 58.83 | 8 | PE | 140 | 0.30 | 187,219 | 0.03 | 0.51 |
| P-2240 | 58.52 | 8 | PE | 140 | 0.35 | 215,622 | 0.04 | 0.66 |
| P-2241 | 63.70 | 8 | PE | 140 | 0.40 | 246,118 | 0.05 | 0.85 |
| P-2242 | 66.75 | 8 | PE | 140 | 0.48 | 294,179 | 0.08 | 1.18 |
| P-2243 | 72.24 | 10 | PE | 140 | 0.41 | 393,463 | 0.05 | 0.68 |
| P-2244 | 51.51 | 10 | PE | 140 | 0.46 | 439,870 | 0.04 | 0.84 |
| P-2245 | 39.62 | 6 | PE | 140 | 0.59 | 205,475 | 0.10 | 2.47 |
| P-2246 | 19.51 | 6 | PE | 140 | 0.21 | 72,714 | 0.01 | 0.36 |
| P-2247 | 186.54 | 4 | PE | 140 | 0.18 | 27,717 | 0.08 | 0.43 |
| P-2248 | 126.80 | 4 | PE | 140 | 0.06 | 9,027 | 0.01 | 0.05 |
| P-2249 | 119.79 | 6 | PE | 140 | 0.29 | 101,575 | 0.08 | 0.67 |
| P-2250 | 216.10 | 8 | PE | 140 | 0.20 | 120,265 | 0.05 | 0.23 |
| P-2251 | 213.06 | 6 | PE | 140 | 0.23 | 80,594 | 0.09 | 0.44 |
| P-2253 | 80.47 | 6 | PE | 140 | 0.27 | 91,912 | 0.04 | 0.56 |
| P-2254 | 72.54 | 6 | PE | 140 | 0.07 | 22,552 | 0.00 | 0.04 |
| P-2255 | 49.38 | 6 | PE | 140 | 0.23 | 80,966 | 0.02 | 0.44 |
| P-2256 | 54.25 | 6 | PE | 140 | 0.18 | 61,904 | 0.01 | 0.27 |
| P-2257 | 71.02 | 6 | PE | 140 | 0.20 | 70,021 | 0.02 | 0.34 |
| P-2258 | 206.96 | 6 | PE | 140 | 0.29 | 99,656 | 0.13 | 0.65 |
| P-2259 | 244.45 | 4 | PE | 140 | 0.17 | 25,753 | 0.09 | 0.38 |

**Table A123.2.2 Results of the Sample Network Analysis (Pipes) 2/3**

| Pipe ID | Length (m) | Diameter (in) | Material | Hazen-Williams C | Velocity (m/s) | Discharge (gal(Imp)/d) | Pressure Pipe Headloss (m) | Headloss Gradient (m/km) |
|---|---|---|---|---|---|---|---|---|
| P-2260 | 116.43 | 3 | PE | 140 | 0.22 | 18,690 | 0.10 | 0.85 |
| P-2261 | 96.93 | 6 | PE | 140 | 0.49 | 170,043 | 0.17 | 1.74 |
| P-2262 | 78.94 | 6 | PE | 140 | 0.41 | 142,050 | 0.10 | 1.24 |
| P-2264 | 92.05 | 4 | PE | 140 | 0.48 | 73,303 | 0.24 | 2.63 |
| P-2265 | 58.22 | 3 | PE | 140 | 0.23 | 20,002 | 0.06 | 0.96 |
| P-2266 | 59.13 | 3 | PE | 140 | 0.11 | 9,304 | 0.01 | 0.23 |
| P-2267 | 92.66 | 3 | PE | 140 | 0.34 | 29,388 | 0.18 | 1.97 |
| P-2268 | 58.83 | 4 | PE | 140 | 0.48 | 74,615 | 0.16 | 2.72 |
| P-2269 | 60.35 | 4 | PE | 140 | 0.30 | 46,636 | 0.07 | 1.14 |
| P-2271 | 62.48 | 6 | PE | 140 | 0.40 | 137,817 | 0.07 | 1.18 |
| P-2272 | 60.35 | 6 | PE | 140 | 0.56 | 193,745 | 0.13 | 2.21 |
| P-2274 | 96.32 | 4 | PE | 140 | 0.18 | 27,836 | 0.04 | 0.44 |
| P-2275 | 60.35 | 4 | PE | 140 | 0.20 | 31,149 | 0.03 | 0.54 |
| P-2276 | 68.88 | 4 | PE | 140 | 0.45 | 69,649 | 0.17 | 2.40 |
| P-2277 | 153.62 | 4 | PE | 140 | 0.26 | 40,295 | 0.13 | 0.87 |
| P-2278 | 60.66 | 4 | PE | 140 | 0.16 | 24,939 | 0.02 | 0.36 |
| P-2279 | 79.55 | 4 | PE | 140 | 0.15 | 23,819 | 0.03 | 0.33 |
| P-2280 | 152.40 | 3 | PE | 140 | 0.23 | 19,810 | 0.14 | 0.95 |
| P-2283 | 61.87 | 4 | PE | 140 | 0.21 | 32,108 | 0.04 | 0.57 |
| P-2284 | 61.26 | 6 | PE | 140 | 0.03 | 10,377 | 0.00 | 0.01 |
| P-2285 | 61.26 | 6 | PE | 140 | 0.03 | 9,572 | 0.00 | 0.01 |
| P-2286 | 66.45 | 6 | PE | 140 | 0.28 | 97,629 | 0.04 | 0.62 |
| P-2287 | 104.85 | 6 | PE | 140 | 0.34 | 116,319 | 0.09 | 0.86 |
| P-2288 | 67.67 | 6 | PE | 140 | 0.39 | 135,009 | 0.08 | 1.13 |
| P-2289 | 86.26 | 4 | PE | 140 | 0.06 | 9,289 | 0.00 | 0.06 |
| P-2290 | 57.91 | 4 | PE | 140 | 0.06 | 9,401 | 0.00 | 0.06 |
| P-2291 | 62.18 | 6 | PE | 140 | 0.10 | 34,572 | 0.01 | 0.09 |
| P-2292 | 29.26 | 6 | PE | 140 | 0.05 | 15,882 | 0.00 | 0.02 |
| P-2293 | 70.41 | 6 | PE | 140 | 0.20 | 70,385 | 0.02 | 0.34 |
| P-2294 | 103.94 | 6 | PE | 140 | 0.26 | 89,075 | 0.05 | 0.52 |
| P-2295 | 118.26 | 6 | PE | 140 | 0.21 | 74,060 | 0.04 | 0.37 |
| P-2296 | 65.53 | 6 | PE | 140 | 0.16 | 55,370 | 0.01 | 0.22 |
| P-2297 | 93.57 | 4 | PE | 140 | 0.30 | 46,544 | 0.11 | 1.14 |
| P-2298 | 38.71 | 6 | PE | 140 | 0.20 | 69,367 | 0.01 | 0.33 |
| P-2299 | 58.83 | 6 | PE | 140 | 0.15 | 50,677 | 0.01 | 0.18 |
| P-2300 | 61.57 | 4 | PE | 140 | 0.18 | 27,049 | 0.03 | 0.42 |
| P-2301 | 83.21 | 4 | PE | 140 | 0.05 | 8,359 | 0.00 | 0.05 |
| P-2302 | 83.52 | 3 | PE | 140 | 0.17 | 14,949 | 0.05 | 0.56 |
| P-2303 | 55.78 | 3 | PE | 140 | 0.01 | 981 | 0.00 | 0.00 |
| P-2304 | 58.22 | 3 | PE | 140 | 0.12 | 10,653 | 0.02 | 0.30 |
| P-2305 | 97.54 | 3 | PE | 140 | 0.03 | 2,760 | 0.00 | 0.02 |
| P-2306 | 97.54 | 3 | PE | 140 | 0.10 | 9,018 | 0.02 | 0.22 |
| P-2307 | 100.89 | 4 | PE | 140 | 0.17 | 26,355 | 0.04 | 0.40 |
| P-2308 | 54.86 | 4 | PE | 140 | 0.02 | 2,988 | 0.00 | 0.01 |
| P-2309 | 57.30 | 4 | PE | 140 | 0.09 | 13,319 | 0.01 | 0.11 |
| P-2310 | 181.97 | 3 | PE | 140 | 0.22 | 18,712 | 0.16 | 0.85 |
| P-2311 | 29.87 | 3 | PE | 140 | 0.00 | 22 | 0.00 | 0.00 |
| P-2312 | 58.52 | 3 | PE | 140 | 0.22 | 18,668 | 0.05 | 0.85 |
| P-2317 | 195.68 | 3 | PE | 140 | 0.16 | 14,118 | 0.10 | 0.51 |
| P-2320 | 57.91 | 4 | PE | 140 | 0.07 | 11,325 | 0.00 | 0.08 |
| P-2321 | 59.74 | 4 | PE | 140 | 0.14 | 21,851 | 0.02 | 0.28 |
| P-2322 | 57.91 | 4 | PE | 140 | 0.15 | 22,383 | 0.02 | 0.29 |

**Table A123.2.2 Results of the Sample Network Analysis (Pipes) 3/3**

| Pipe ID | Length (m) | Diameter (in) | Material | Hazen-Williams C | Velocity (m/s) | Discharge (gal(Imp)/d) | Pressure Pipe Headloss (m) | Headloss Gradient (m/km) |
|---|---|---|---|---|---|---|---|---|
| P-2323 | 61.57 | 4 | PE | 140 | 0.19 | 29,267 | 0.03 | 0.48 |
| P-2324 | 67.67 | 4 | PE | 140 | 0.12 | 18,586 | 0.01 | 0.21 |
| P-2325 | 66.14 | 6 | PE | 140 | 0.33 | 113,236 | 0.05 | 0.82 |
| P-2326 | 121.31 | 6 | PE | 140 | 0.22 | 75,959 | 0.05 | 0.39 |
| P-2327 | 56.08 | 6 | PE | 140 | 0.14 | 48,824 | 0.01 | 0.17 |
| P-2328 | 90.83 | 6 | PE | 140 | 0.18 | 63,006 | 0.03 | 0.28 |
| P-2329 | 70.71 | 4 | PE | 140 | 0.21 | 32,871 | 0.04 | 0.60 |
| P-2330 | 202.39 | 3 | PE | 140 | 0.07 | 5,698 | 0.02 | 0.09 |
| P-2331 | 201.47 | 3 | PE | 140 | 0.09 | 8,164 | 0.04 | 0.18 |
| P-2332 | 198.73 | 3 | PE | 140 | 0.11 | 9,713 | 0.05 | 0.25 |
| P-2333 | 198.73 | 3 | PE | 140 | 0.14 | 11,806 | 0.07 | 0.36 |
| P-2334 | 199.64 | 4 | PE | 140 | 0.19 | 29,371 | 0.10 | 0.48 |
| P-2335 | 68.28 | 6 | PE | 140 | 0.11 | 39,723 | 0.01 | 0.12 |
| P-2336 | 119.48 | 6 | PE | 140 | 0.09 | 32,514 | 0.01 | 0.08 |
| P-2337 | 57.91 | 6 | PE | 140 | 0.04 | 13,824 | 0.00 | 0.02 |
| P-2338 | 73.76 | 4 | PE | 140 | 0.29 | 44,499 | 0.08 | 1.04 |
| P-2339 | 53.64 | 4 | PE | 140 | 0.07 | 11,481 | 0.00 | 0.08 |
| P-2340 | 202.69 | 4 | PE | 140 | 0.24 | 36,678 | 0.15 | 0.73 |
| P-2341 | 60.96 | 4 | PE | 140 | 0.04 | 6,508 | 0.00 | 0.03 |
| P-2342 | 59.13 | 4 | PE | 140 | 0.03 | 4,254 | 0.00 | 0.01 |
| P-2343 | 58.52 | 4 | PE | 140 | 0.00 | 70 | 0.00 | 0.00 |
| P-2344 | 55.17 | 4 | PE | 140 | 0.03 | 4,991 | 0.00 | 0.02 |
| P-2345 | 77.42 | 6 | PE | 140 | 0.14 | 49,365 | 0.01 | 0.18 |
| P-2346 | 78.03 | 6 | PE | 140 | 0.17 | 59,585 | 0.02 | 0.25 |
| P-2347 | 181.97 | 6 | PE | 140 | 0.23 | 78,275 | 0.08 | 0.41 |
| P-2348 | 202.39 | 3 | PE | 140 | 0.16 | 13,461 | 0.09 | 0.46 |
| P-2349 | 203.91 | 3 | PE | 140 | 0.16 | 13,629 | 0.10 | 0.47 |
| P-2350 | 203.00 | 3 | PE | 140 | 0.17 | 14,506 | 0.11 | 0.53 |
| P-2351 | 202.69 | 3 | PE | 140 | 0.19 | 16,436 | 0.14 | 0.67 |
| P-2352 | 77.42 | 4 | PE | 140 | 0.34 | 52,503 | 0.11 | 1.42 |
| P-2353 | 106.68 | 4 | PE | 140 | 0.22 | 33,813 | 0.07 | 0.63 |
| P-2358 | 103.02 | 3 | PE | 140 | 0.12 | 10,025 | 0.03 | 0.27 |
| P-2359 | 78.64 | 3 | PE | 140 | 0.33 | 28,715 | 0.15 | 1.89 |
| P-2360 | 184.40 | 6 | PE | 140 | 0.12 | 42,649 | 0.02 | 0.13 |
| P-2363 | 181.66 | 4 | PE | 140 | 0.23 | 35,724 | 0.13 | 0.70 |
| P-2364 | 185.93 | 3 | PE | 140 | 0.07 | 6,228 | 0.02 | 0.11 |
| P-2368 | 106.98 | 3 | PE | 140 | 0.29 | 25,316 | 0.16 | 1.49 |
| P-2369 | 77.11 | 3 | PE | 140 | 0.51 | 44,006 | 0.32 | 4.16 |
| P-2370 | 119.79 | 3 | PE | 140 | 0.14 | 12,233 | 0.05 | 0.39 |
| P-2371 | 77.72 | 3 | PE | 140 | 0.36 | 30,923 | 0.17 | 2.16 |
| P-2372 | 31.39 | 10 | PE | 140 | 0.36 | 346,463 | 0.02 | 0.54 |
| P-2375 | 15.85 | 6 | PE | 140 | 0.39 | 134,719 | 0.02 | 1.13 |
| P-2402 | 14.94 | 6 | PE | 140 | 0.44 | 151,450 | 0.02 | 1.40 |
| P-2405 | 60.96 | 4 | PE | 140 | 0.15 | 23,147 | 0.02 | 0.31 |
| P-2406 | 67.36 | 4 | PE | 140 | 0.03 | 4,457 | 0.00 | 0.01 |
| P-2407 | 91.74 | 4 | PE | 140 | 0.18 | 28,419 | 0.04 | 0.46 |
| P-2408 | 42.67 | 4 | PE | 140 | 0.06 | 9,729 | 0.00 | 0.06 |
| P-2508 | 65.53 | 3 | PE | 140 | 0.14 | 12,462 | 0.03 | 0.40 |
| P-2509 | 73.15 | 4 | PE | 140 | 0.11 | 17,034 | 0.01 | 0.18 |
| P-2510 | 75.59 | 6 | PE | 140 | 0.18 | 61,339 | 0.02 | 0.26 |
| P-2511 | 69.19 | 4 | PE | 140 | 0.10 | 15,123 | 0.01 | 0.14 |
| P-2512 | 71.93 | 3 | PE | 140 | 0.10 | 8,665 | 0.01 | 0.20 |
| P-2513 | 85.95 | 3 | PE | 140 | 0.08 | 6,626 | 0.01 | 0.12 |

## Table A123.2.3 Results of the Sample Network Analysis (Junctions)

| Junctioin ID | Relative Elevation (m) | Flow (Demand * 1.5) (gal(Imp)/d) | Pressure (m H2O) |
|---|---|---|---|
| J-1460 | 0 | 18,690 | 14.97 |
| J-1461 | 0 | 18,690 | 14.95 |
| J-1462 | 0 | 18,690 | 14.94 |
| J-1463 | 0 | 18,690 | 14.93 |
| J-1464 | 0 | 18,690 | 14.90 |
| J-1465 | 0 | 18,690 | 14.89 |
| J-1466 | 0 | 18,690 | 14.89 |
| J-1467 | 0 | 18,690 | 14.89 |
| J-1468 | 0 | 18,690 | 14.93 |
| J-1469 | 0 | 18,690 | 14.96 |
| J-1470 | 0 | 18,690 | 14.91 |
| J-1471 | 0 | 18,690 | 14.87 |
| J-1472 | 0 | 18,690 | 14.85 |
| J-1473 | 0 | 18,690 | 14.84 |
| J-1474 | 0 | 18,690 | 14.84 |
| J-1475 | 0 | 18,690 | 14.92 |
| J-1477 | 0 | 18,690 | 14.65 |
| J-1478 | 0 | 18,690 | 14.60 |
| J-1479 | 0 | 18,690 | 14.32 |
| J-1480 | 0 | 18,690 | 14.22 |
| J-1481 | 0 | 18,690 | 14.17 |
| J-1482 | 0 | 18,690 | 14.09 |
| J-1483 | 0 | 18,690 | 14.11 |
| J-1484 | 0 | 18,690 | 14.12 |
| J-1485 | 0 | 18,690 | 14.14 |
| J-1486 | 0 | 18,690 | 14.17 |
| J-1487 | 0 | 18,690 | 14.24 |
| J-1488 | 0 | 18,690 | 14.35 |
| J-1489 | 0 | 18,690 | 14.46 |
| J-1490 | 0 | 18,690 | 14.50 |
| J-1491 | 0 | 18,690 | 14.59 |
| J-1492 | 0 | 18,690 | 14.65 |
| J-1493 | 0 | 18,690 | 14.68 |
| J-1494 | 0 | 18,690 | 14.71 |
| J-1495 | 0 | 18,690 | 14.75 |
| J-1496 | 0 | 18,690 | 14.80 |
| J-1497 | 0 | 18,690 | 14.88 |
| J-1498 | 0 | 18,690 | 14.93 |
| J-1499 | 0 | 18,690 | 14.45 |
| J-1500 | 0 | 18,690 | 14.85 |
| J-1501 | 0 | 18,690 | 14.84 |
| J-1502 | 0 | 18,690 | 14.92 |
| J-1503 | 0 | 18,690 | 14.79 |
| J-1504 | 0 | 18,690 | 14.79 |
| J-1505 | 0 | 18,690 | 14.80 |
| J-1506 | 0 | 18,690 | 14.82 |
| J-1507 | 0 | 18,690 | 14.77 |
| J-1508 | 0 | 18,690 | 14.70 |
| J-1509 | 0 | 18,690 | 14.60 |
| J-1510 | 0 | 18,690 | 14.67 |
| J-1511 | 0 | 18,690 | 14.58 |
| J-1512 | 0 | 18,690 | 14.60 |
| J-1513 | 0 | 18,690 | 14.66 |
| J-1514 | 0 | 18,690 | 14.44 |
| J-1515 | 0 | 18,690 | 14.38 |
| J-1516 | 0 | 18,690 | 14.37 |
| J-1517 | 0 | 18,690 | 14.44 |
| J-1518 | 0 | 18,690 | 14.40 |
| J-1519 | 0 | 18,690 | 14.43 |
| J-1520 | 0 | 18,690 | 14.27 |
| J-1521 | 0 | 18,690 | 14.29 |
| J-1522 | 0 | 18,690 | 14.13 |
| J-1523 | 0 | 18,690 | 14.16 |
| J-1524 | 0 | 18,690 | 14.16 |
| J-1525 | 0 | 18,690 | 14.16 |
| J-1526 | 0 | 18,690 | 14.20 |
| J-1527 | 0 | 18,690 | 14.29 |
| J-1528 | 0 | 18,690 | 14.44 |
| J-1529 | 0 | 18,690 | 14.37 |
| J-1530 | 0 | 18,690 | 14.60 |
| J-1531 | 0 | 18,690 | 14.17 |
| J-1532 | 0 | 18,690 | 14.15 |
| J-1533 | 0 | 18,690 | 14.14 |
| J-1534 | 0 | 18,690 | 14.14 |
| J-1535 | 0 | 18,690 | 14.13 |
| J-1536 | 0 | 18,690 | 14.11 |
| J-1537 | 0 | 18,690 | 14.11 |
| J-1538 | 0 | 18,690 | 14.13 |
| J-1539 | 0 | 18,690 | 14.09 |
| J-1540 | 0 | 18,690 | 14.09 |
| J-1542 | 0 | 18,690 | 14.36 |
| J-1545 | 0 | 18,690 | 14.64 |
| J-1546 | 0 | 18,690 | 14.64 |
| J-1547 | 0 | 18,690 | 14.66 |
| J-1548 | 0 | 18,690 | 14.67 |
| J-1549 | 0 | 18,690 | 14.70 |
| J-1550 | 0 | 18,690 | 14.72 |
| J-1551 | 0 | 18,690 | 14.67 |
| J-1552 | 0 | 18,690 | 14.66 |
| J-1553 | 0 | 18,690 | 14.79 |
| J-1554 | 0 | 18,690 | 14.78 |
| J-1555 | 0 | 18,690 | 14.78 |
| J-1556 | 0 | 18,690 | 14.79 |
| J-1557 | 0 | 18,690 | 14.79 |
| J-1558 | 0 | 18,690 | 14.79 |
| J-1559 | 0 | 18,690 | 14.79 |
| J-1560 | 0 | 18,690 | 14.79 |
| J-1561 | 0 | 18,690 | 14.81 |
| J-1562 | 0 | 18,690 | 14.82 |
| J-1563 | 0 | 18,690 | 14.75 |
| J-1565 | 0 | 18,690 | 14.74 |
| J-1567 | 0 | 18,690 | 14.73 |
| J-1568 | 0 | 18,690 | 14.76 |
| J-1569 | 0 | 18,690 | 14.62 |
| J-1570 | 0 | 18,690 | 14.37 |
| J-1571 | 0 | 18,690 | 14.33 |
| J-1573 | 0 | 18,690 | 14.39 |
| J-1574 | 0 | 18,690 | 14.55 |
| J-1575 | 0 | 18,690 | 14.79 |
| J-1599 | 0 | 18,690 | 14.11 |
| J-1600 | 0 | 18,690 | 14.13 |

# APPENDIX – A124.1

## Details of Preliminary Design of Pipes

## A124.1 Details of Preliminary Design of Pipes

### A. Condition of Preliminary Design

Criteria adopted for design of branch and trunk sewers at the feasibility study stage are shown in **Table A124.1.1.** Minimum covering for branch sewer, sub-main sewer and trunk sewer, and minimum clearance between bed of nallah and pipe of culvert structure are included in the table.

**Table A124.1.1 Design Criteria for Branch Sewer, Sub-main Sewer and Trunk Sewer**

| Item | Criteria |
|---|---|
| (1) Design flow | Peak flow (Maximum hourly sewage flow)<br>Peak factor: 1.5 |
| (2) Flow formula<br>Gravity flow | <br>Manning's formula<br>$Q = A \times V$<br>$V = (1/n) \times R^{(2/3)} \times I^{(1/2)}$<br>Where Q: Flow rate ($m^3/s$)<br>A: Flow section ($m^2$)<br>V: Flow velocity (m/s)<br>n: Roughness coefficient (Manning's n)<br>Manning's n=0.015, for concrete pipe and box culvert<br>R: Hydraulic radius (m)<br>I: Gradient |
| (3) Depth of flow | Full depth for pipe<br>90% depth for box culvert |
| (4) Minimum Velocity | 0.8 m/s |
| (5) Maximum Velocity | 3.0 m/s |
| (6) Diameter of Sewer | Branch Sewer: 10" (254 mm)<br>Sub-main Sewer: 12" to 36" (305 mm to 914 mm)<br>Trunk Sewer: 42" (1000mm) or larger |
| (7) Pipe materials | Ready-made concrete pipe for gravity sewer<br>Cast iron pipe for pressure main |
| (8) Diameter of ready-made concrete pipe | For branch sewer<br>10" (254 mm)<br>For sub-main sewer<br>12", 15", 18", 24", 27", 33", 36"<br>(305, 381, 457, 610, 686, 838 and 914 mm, respectively)<br>For trunk sewer<br>42", 48"', 54", 66", 72' and 84"<br>(1070, 1220, 1370, 1680, 1830 and 2130 mm, respectively)<br>Concrete pipes of these diameters are produced at a factory in Karachi. Box culvert will be adopted when large diameter of more than 84' is required |
| (9) Minimum Covering | Branch Sewer: 1.0m for local streets, 1.5m for main streets<br>Sub-main Sewer: 2.0m<br>Trunk Sewer: 4.0m |
| (10) Minimum clearance between bed of nallah and pipe, or culvert structure | 1.0 m |

## B. Sewer District Allocation and Trunk Sewer Allignment

The preliminary design at the feasibility study stage was done using the results of leveling survey and detailed street map developed in GIS study.

**In Master Plan Target Year, 2025**

Three sewer districts of TP-1, TP-2 and TP-3 exist in the priority project area. TP-2 District is a small strip along Lyari River in Gulberg Town. Sewage generated in the strip will flow into sewage treatment plant TP-3 at feasibility study stage and will be diverted to TP-2 crossing Lyari River after 2021. Other small strips along Lyari River in Liaquatabad Town and along Gujjar Nallah belong to TP-3 District. Sewage generated in this area flows into TP-3 through Gujjar Nallah and existing Lyari interceptor. As a result, the remaining area belong to TP-1 District and the sewage reaches TP-1 through new trunk sewers. **Figure A142.1.1** shows alignment of trunk sewers and sub-main sewers in 2025.

**In Priority Project Target Year, 2016**

Treatment capacity of rehabilitated TP-1 is limited to 24.2 mgd or 110,000 $m^3$/d in 2016. This capacity is not enough for sewage generation of whole TP-1 District; therefore, sewage in some part of TP-1 District will be diverted to rehabilitated TP-3 which has enough treatment capacity, 53.9 mgd or 245,000 $m^3$/d in 2016. **Figure A142.1.2** shows alignment of trunk sewers and sub-main sewers in 2016. Catchment area of node 15, 16, 17, 25 (part) and 26 (part) will be temporally shifted to TP-3 District. At the same time, existing trunk sewer connecting to TP-1 has enough flow capacity; therefore, the downstream end of proposed trunk sewers is to be connected to the existing trunk sewer in Liaquatabad Town. Sewer district allocation in 2016 and 2025 are shown in **Figure A142.1.3**.

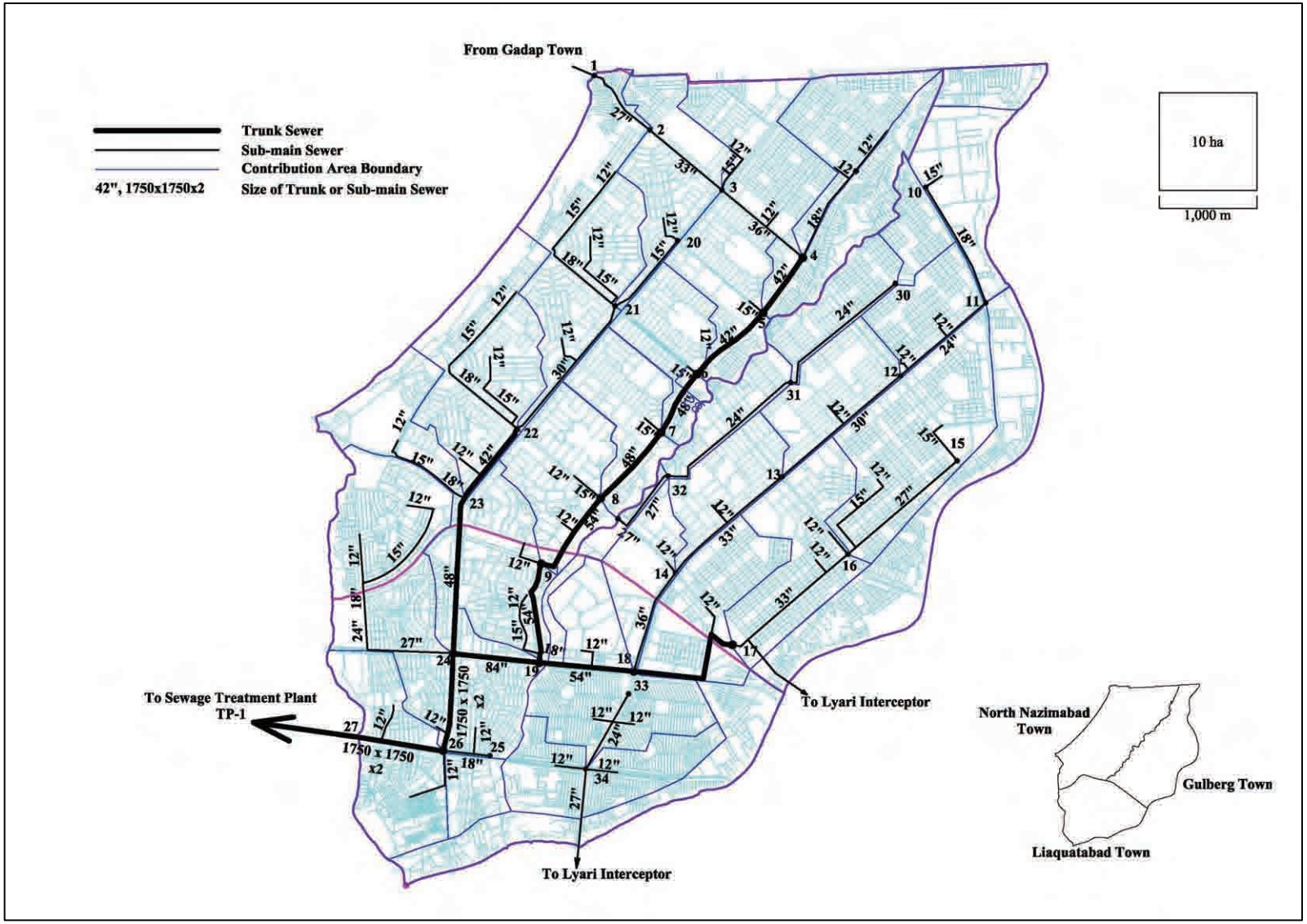



**Figure A124.1.1 General Plan of Priority Project Area (2025)**

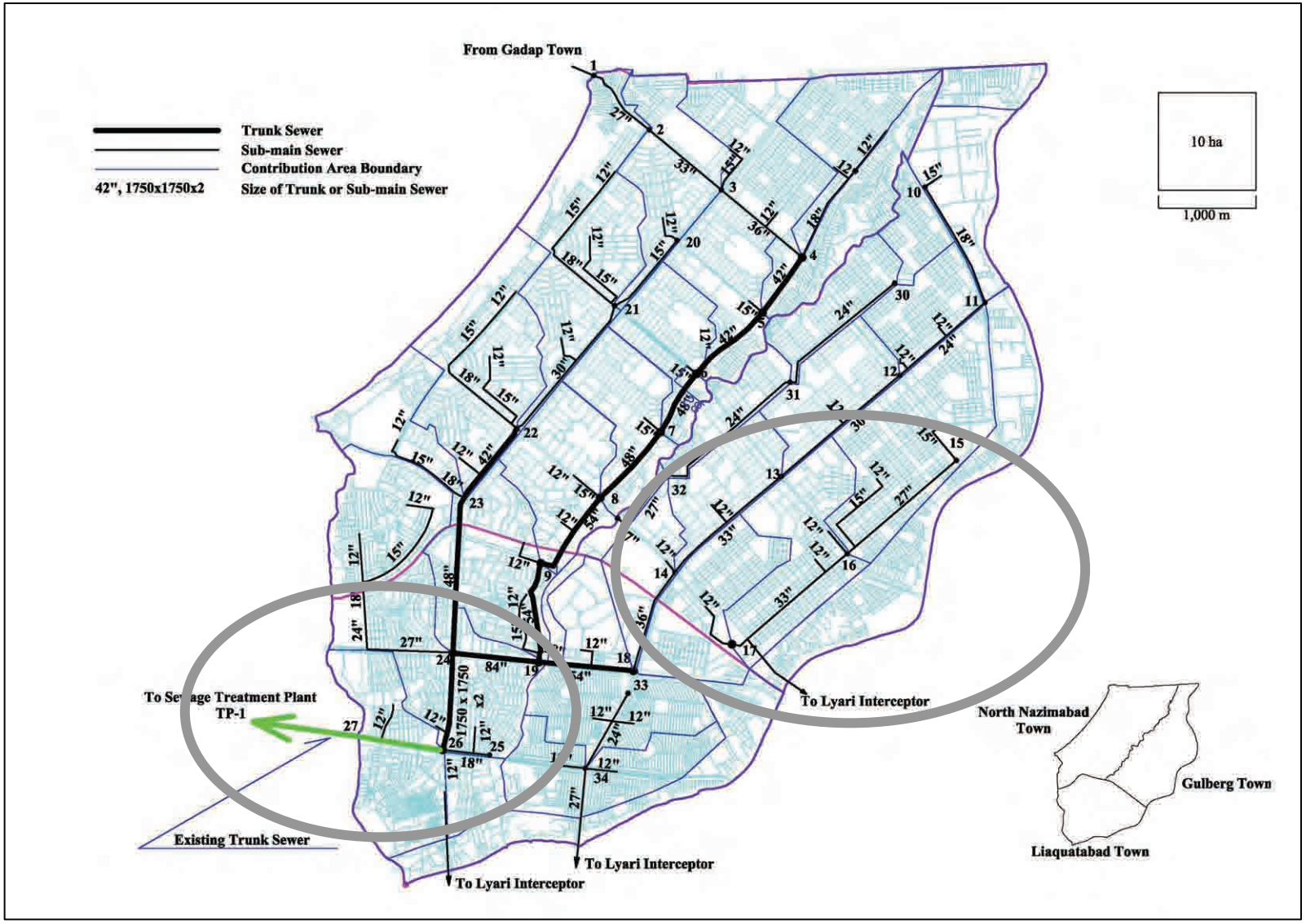



**Figure A124.1.2 General Plan of Priority Proect Area (2016)**

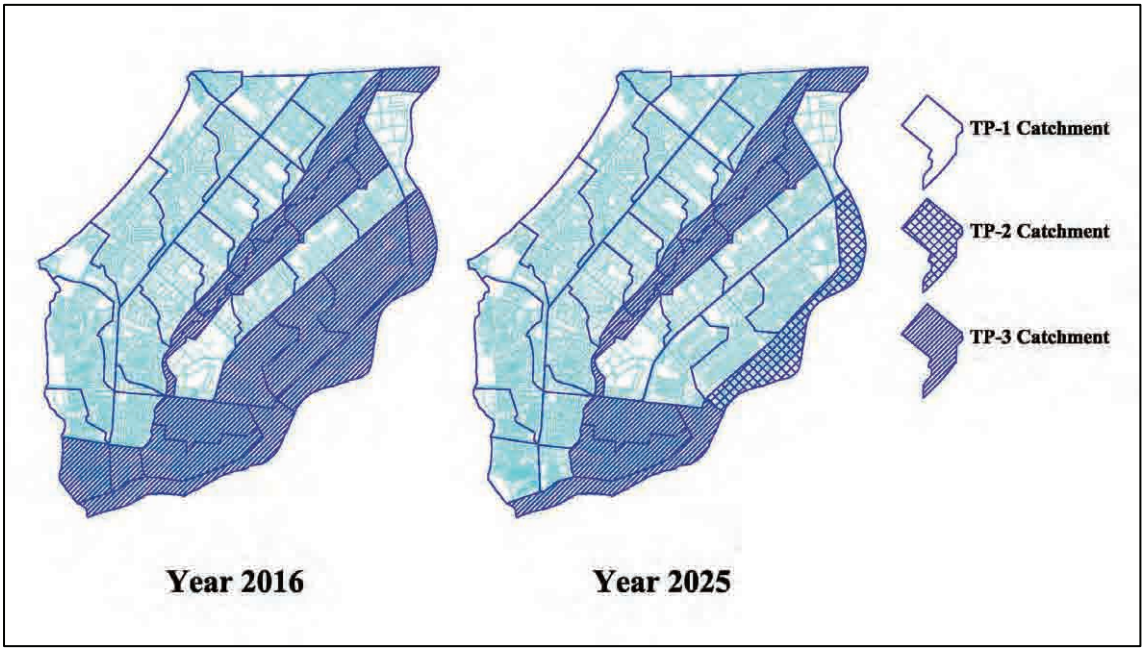



**Figure A124.1.3 Sewer Districts Allocation in 2016 and 2025**

## C. Flow Calculation

Flow calculation sheets for trunk sewers and some sub-main sewers for 2025 and 2016 are shown in **Table A124.1.1** and **Table A1241.1.2** respectively. Design flow is calculated based on population of each contribution area and per-capita sewage generation. Manning formula is adopted to calculate flow velocity in conduit and culvert.

## D. Longitudinal Section of Trunk Sewer and Sub-main Sewer

Longitudinal Section of Trunk Sewer and Sub-main Sewer are shown in **Figure A124.1.4** to **Figure A124.1.7**.

# Table A124.1.2 Flow Calculation Sheet (2025)

| Node | | Catchment Area (ha) | | Population (In coverd area) | | Average Flow ($m^3/s$) (Flow to STP) | | Peak Flow ($m^3/s$) | Diameter (inch) | Diameter or Width (mm) | Hight (mm) | Number of Stream | Length (m) | Gradient (1/x) | Ground level (m) | | Invert level (m) | | Covering (m) | | Velocity (m/s) | Flow Capacity ($m^3/s$) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| From | To | Increment | Cumulative | Increment | Cumulative | Increment | Cumulative | | | | | | | | Up Stream | Down Stream | Up Stream | Down Stream | Up Stream | Down Stream | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **To TP-1** | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | 0.153 | | | | | | | | | | | | | | | | From Gadap Town |
| 1 | 2 | 8.4 | 8.4 | 6,293 | 6,293 | 0.006 | 0.159 | 0.239 | 27 | 686 | | | 820 | 660 | 57.19 | 46.19 | 54.30 | 43.30 | 2.00 | 2.00 | 0.80 | 0.296 | |
| 2 | 3 | 55.5 | 63.9 | 41,579 | 47,873 | 0.041 | 0.200 | 0.301 | 33 | 838 | | | 970 | 860 | 46.19 | 37.07 | 43.15 | 34.03 | 2.00 | 2.00 | 0.80 | 0.443 | |
| 3 | 4 | 140.6 | 204.5 | 105,335 | 153,207 | 0.104 | 0.305 | 0.457 | 36 | 914 | | | 1,080 | 970 | 37.07 | 30.64 | 33.96 | 27.53 | 2.00 | 2.00 | 0.80 | 0.525 | |
| 4 | 5 | 124.3 | 328.8 | 93,123 | 246,330 | 0.092 | 0.397 | 0.595 | 42 | 1,067 | | | 710 | 1,190 | 30.64 | 28.75 | 25.37 | 23.48 | 4.00 | 4.00 | 0.80 | 0.717 | |
| 5 | 6 | 98.9 | 427.7 | 74,094 | 320,424 | 0.073 | 0.470 | 0.705 | 42 | 1,067 | | | 940 | 1,190 | 28.75 | 26.00 | 23.48 | 20.73 | 4.00 | 4.00 | 0.80 | 0.717 | |
| 6 | 7 | 83.4 | 511.1 | 62,482 | 382,905 | 0.062 | 0.532 | 0.798 | 48 | 1,219 | | | 710 | 1,420 | 26.00 | 24.32 | 20.58 | 18.90 | 4.00 | 4.00 | 0.80 | 0.936 | |
| 7 | 8 | 86.7 | 597.8 | 64,954 | 447,859 | 0.064 | 0.596 | 0.894 | 48 | 1,219 | | | 920 | 1,420 | 24.32 | 22.14 | 18.90 | 16.72 | 4.00 | 4.00 | 0.80 | 0.936 | |
| 8 | 9 | 121.9 | 719.7 | 91,325 | 539,184 | 0.090 | 0.686 | 1.030 | 54 | 1,372 | | | 990 | 1,670 | 22.14 | 18.82 | 16.57 | 13.25 | 4.00 | 4.00 | 0.80 | 1.183 | |
| 9 | 19 | 132.8 | 852.5 | 99,491 | 638,675 | 0.098 | 0.785 | 1.177 | 54 | 1,372 | | | 1,060 | 1,670 | 18.82 | 18.12 | 13.25 | 12.55 | 4.00 | 4.00 | 0.80 | 1.183 | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | 11 | 112.3 | 112.3 | 84,133 | 84,133 | 0.083 | 0.083 | 0.125 | 18 | 457 | | | 1,350 | 380 | 33.00 | 31.02 | 30.34 | 26.79 | 2.00 | 3.57 | 0.81 | 0.132 | |
| 11 | 12 | 81.9 | 194.2 | 61,358 | 145,491 | 0.061 | 0.144 | 0.216 | 24 | 610 | | | 1,160 | 560 | 31.02 | 28.89 | 26.64 | 24.57 | 3.57 | 3.51 | 0.81 | 0.235 | |
| 12 | 13 | 104.4 | 298.6 | 78,214 | 223,705 | 0.077 | 0.221 | 0.332 | 30 | 762 | | | 1,600 | 760 | 28.89 | 25.30 | 24.41 | 22.31 | 3.51 | 2.03 | 0.80 | 0.366 | |
| 13 | 14 | 91.5 | 390.1 | 68,550 | 292,255 | 0.068 | 0.289 | 0.434 | 33 | 838 | | | 1,480 | 860 | 25.30 | 21.66 | 22.26 | 18.62 | 2.00 | 2.00 | 0.80 | 0.443 | |
| 14 | 18 | 77.9 | 468.0 | 58,361 | 350,616 | 0.058 | 0.347 | 0.520 | 36 | 914 | | | 1,130 | 970 | 21.66 | 17.48 | 18.55 | 14.37 | 2.00 | 2.00 | 0.80 | 0.525 | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| 15 | 16 | 219.0 | 219.0 | 164,070 | 164,070 | 0.162 | 0.162 | 0.243 | 27 | 686 | | | 1,480 | 660 | 27.00 | 24.30 | 24.11 | 21.41 | 2.00 | 2.00 | 0.80 | 0.296 | |
| 16 | 17 | 161.4 | 380.4 | 120,917 | 284,988 | 0.120 | 0.282 | 0.423 | 33 | 838 | | | 1,610 | 860 | 24.30 | 18.30 | 21.26 | 15.26 | 2.00 | 2.00 | 0.80 | 0.443 | |
| 17 | 18 | 138.2 | 518.6 | 103,537 | 388,524 | 0.102 | 0.384 | 0.577 | 42 | 1,067 | | | 1,470 | 1,190 | 18.30 | 17.48 | 13.03 | 11.80 | 4.00 | 4.42 | 0.80 | 0.717 | |
| 18 | 19 | 61.7 | 1,048.3 | 46,224 | 785,364 | 0.046 | 0.777 | 1.166 | 54 | 1,372 | | | 980 | 1,670 | 17.48 | 18.12 | 10.49 | 9.90 | 5.42 | 6.64 | 0.80 | 1.183 | |
| 19 | 24 | 17.9 | 1,918.7 | 13,410 | 1,437,450 | 0.013 | 1.575 | 2.363 | 84 | 2,134 | | | 890 | 3,000 | 18.12 | 18.70 | 9.14 | 8.84 | 6.64 | 7.52 | 0.80 | 2.865 | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| 20 | 21 | 76.6 | 76.6 | 57,387 | 57,387 | 0.057 | 0.057 | 0.085 | 15 | 381 | | | 940 | 300 | 33.43 | 28.69 | 30.85 | 26.11 | 2.00 | 2.00 | 0.80 | 0.092 | |
| 21 | 22 | 236.7 | 313.3 | 177,331 | 234,718 | 0.175 | 0.232 | 0.348 | 30 | 762 | | | 1,630 | 760 | 28.69 | 23.84 | 25.73 | 20.88 | 2.00 | 2.00 | 0.80 | 0.366 | |
| 22 | 23 | 208.5 | 521.8 | 156,204 | 390,922 | 0.155 | 0.387 | 0.580 | 42 | 1,067 | | | 810 | 1,190 | 23.84 | 25.67 | 18.57 | 17.89 | 4.00 | 6.51 | 0.80 | 0.717 | |
| 23 | 24 | 127.9 | 649.7 | 95,820 | 486,742 | 0.095 | 0.482 | 0.722 | 48 | 1,219 | | | 1,610 | 1,420 | 25.67 | 18.70 | 17.74 | 13.28 | 6.51 | 4.00 | 0.80 | 0.936 | |
| 24 | 26 | 246.3 | 2,814.7 | 184,523 | 2,108,714 | 0.183 | 2.239 | 3.359 | | 1,750 | 1,750 | 2 | 1,010 | 3,400 | 18.70 | 14.82 | 8.48 | 8.19 | 8.27 | 4.68 | 0.80 | 4.272 | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| 25 | 26 | 118.0 | 118.0 | 88,403 | 88,403 | 0.087 | 0.087 | 0.131 | 18 | 457 | | | 480 | 380 | 14.41 | 14.82 | 10.75 | 9.49 | 3.00 | 4.67 | 0.81 | 0.132 | |
| 26 | 27 | 153.8 | 3,086.5 | 115,224 | 2,312,341 | 0.114 | 2.441 | 3.661 | | 1,750 | 1,750 | 2 | 890 | 3,400 | 14.82 | 14.73 | 8.19 | 7.93 | 4.68 | 4.85 | 0.80 | 4.272 | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| 27 | 28 | | 3,086.5 | | 2,312,341 | 0.182 | 2.623 | 3.934 | | 1,750 | 1,750 | 2 | 520 | 3,400 | 14.73 | 16.67 | 7.93 | 7.77 | 4.85 | 6.95 | 0.80 | 4.272 | SITE Town |
| 28 | 29 | | 3,086.5 | | 2,312,341 | | 2.623 | 3.934 | | 1,750 | 1,750 | 2 | 250 | 3,400 | 16.67 | 18.15 | 7.77 | 7.70 | 6.95 | 8.50 | 0.80 | 4.272 | SITE Town |
| 29 | TP-1 | | 3,086.5 | | 2,312,341 | | 2.623 | 3.934 | | 1,750 | 1,750 | 2 | 1,290 | 3,400 | 18.15 | 14.94 | 7.70 | 7.32 | 8.50 | 5.67 | 0.80 | 4.272 | SITE Town |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **To TP-3** | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| 30 | 31 | 125.8 | 125.8 | 94,247 | 94,247 | 0.093 | 0.093 | 0.140 | 24 | 610 | | | 1,560 | 560 | 29.77 | 26.65 | 26.96 | 23.84 | 2.00 | 2.00 | 0.81 | 0.235 | |
| 31 | 32 | 62.6 | 188.4 | 46,899 | 141,145 | 0.046 | 0.140 | 0.209 | 24 | 610 | | | 1,690 | 560 | 26.65 | 21.90 | 23.84 | 19.09 | 2.00 | 2.00 | 0.81 | 0.235 | |
| 32 | Gujjar Nallah | 31.6 | 220.0 | 23,674 | 164,819 | 0.023 | 0.163 | 0.245 | 27 | 686 | | | 810 | 660 | 21.90 | 21.90 | 19.01 | 17.79 | 2.00 | 3.23 | 0.80 | 0.296 | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| 33 | 34 | 126.9 | 126.9 | 95,071 | 95,071 | 0.094 | 0.094 | 0.141 | 24 | 610 | | | 860 | 560 | 17.48 | 13.89 | 14.67 | 11.08 | 2.00 | 2.00 | 0.81 | 0.235 | |
| 34 | Lyari Iterceptor | 129.4 | 256.3 | 96,944 | 192,015 | 0.096 | 0.190 | 0.285 | 27 | 686 | | | 870 | 660 | 13.89 | 9.89 | 11.00 | 7.00 | 2.00 | 2.00 | 0.80 | 0.296 | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **To Gujjar Nallah** | | | | | | | | | | | | | | | | | | | | | | | |
| (1) Right Bank Side | | 180.0 | | 134,852 | | 0.133 | | | | | | | | | | | | | | | | | |
| (2) Left Bank Side | | 41.6 | 221.6 | 31,166 | 166,018 | 0.031 | 0.164 | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **To Lyari Interceptor** | | | | | | | | | | | | | | | | | | | | | | | |
| (1) Gulberg Town | | 210.3 | | 157,552 | | 0.156 | | | | | | | | | | | | | | | | | |
| (2) Liaquatabad Town | | 145.4 | 355.7 | 108,931 | 266,483 | 0.108 | 0.264 | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |

# Table A124.1.3 Flow Calculation Sheet (2016)

| Node | | Catchment Area (ha) | | Population (In coverd area) | | Average Flow ($m^3/s$) (Flow to STP) | | Peak Flow ($m^3/s$) | Diameter (inch) | Diameter or Width (mm) | Hight (mm) | Number of Stream | Length (m) | Gradient (1/x) | Ground level (m) | | Invert level (m) | | Covering (m) | | Velocity (m/s) | Flow Capacity ($m^3/s$) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| From | To | Increment | Cumulative | Increment | Cumulative | Increment | Cumulative | | | | | | | | Up Stream | Down Stream | Up Stream | Down Stream | Up Stream | Down Stream | | | |
| **To TP-1** | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | 0.000 | | | | | | | | | | | | | | | | From Gadap Town |
| 1 | 2 | 8.4 | 8.4 | 5,591 | 5,591 | 0.005 | 0.005 | 0.007 | 27 | 686 | | | 820 | 660 | 57.19 | 46.19 | 54.30 | 43.30 | 2.00 | 2.00 | 0.80 | 0.296 | |
| 2 | 3 | 55.5 | 63.9 | 36,943 | 42,534 | 0.030 | 0.035 | 0.052 | 33 | 838 | | | 970 | 860 | 46.19 | 37.07 | 43.15 | 34.03 | 2.00 | 2.00 | 0.80 | 0.443 | |
| 3 | 4 | 140.6 | 204.5 | 93,589 | 136,124 | 0.076 | 0.111 | 0.166 | 36 | 914 | | | 1,080 | 970 | 37.07 | 30.64 | 33.96 | 27.53 | 2.00 | 2.00 | 0.80 | 0.525 | |
| 4 | 5 | 124.3 | 328.8 | 82,739 | 218,863 | 0.067 | 0.178 | 0.267 | 42 | 1,067 | | | 710 | 1,190 | 30.64 | 28.75 | 25.37 | 23.48 | 4.00 | 4.00 | 0.80 | 0.717 | |
| 5 | 6 | 98.9 | 427.7 | 65,832 | 284,695 | 0.054 | 0.232 | 0.347 | 42 | 1,067 | | | 940 | 1,190 | 28.75 | 26.00 | 23.48 | 20.73 | 4.00 | 4.00 | 0.80 | 0.717 | |
| 6 | 7 | 83.4 | 511.1 | 55,514 | 340,209 | 0.045 | 0.277 | 0.415 | 48 | 1,219 | | | 710 | 1,420 | 26.00 | 24.32 | 20.58 | 18.90 | 4.00 | 4.00 | 0.80 | 0.936 | |
| 7 | 8 | 86.7 | 597.8 | 57,711 | 397,920 | 0.047 | 0.324 | 0.486 | 48 | 1,219 | | | 920 | 1,420 | 24.32 | 22.14 | 18.90 | 16.72 | 4.00 | 4.00 | 0.80 | 0.936 | |
| 8 | 9 | 121.9 | 719.7 | 81,142 | 479,062 | 0.066 | 0.390 | 0.585 | 54 | 1,372 | | | 990 | 1,670 | 22.14 | 18.82 | 16.57 | 13.25 | 4.00 | 4.00 | 0.80 | 1.183 | |
| 9 | 19 | 132.8 | 852.5 | 88,397 | 567,459 | 0.072 | 0.462 | 0.692 | 54 | 1,372 | | | 1,060 | 1,670 | 18.82 | 18.12 | 13.25 | 12.55 | 4.00 | 4.00 | 0.80 | 1.183 | |
| 10 | 11 | 112.3 | 112.3 | 74,751 | 74,751 | 0.061 | 0.061 | 0.091 | 18 | 457 | | | 1,350 | 380 | 33.00 | 31.02 | 30.34 | 26.79 | 2.00 | 3.57 | 0.81 | 0.132 | |
| 11 | 12 | 81.9 | 194.2 | 54,516 | 129,267 | 0.044 | 0.105 | 0.158 | 24 | 610 | | | 1,160 | 560 | 31.02 | 28.89 | 26.64 | 24.57 | 3.57 | 3.51 | 0.81 | 0.235 | |
| 12 | 13 | 104.4 | 298.6 | 69,493 | 198,760 | 0.057 | 0.162 | 0.243 | 30 | 762 | | | 1,600 | 760 | 28.89 | 25.30 | 24.41 | 22.31 | 3.51 | 2.03 | 0.80 | 0.366 | |
| 13 | 14 | 91.5 | 390.1 | 60,906 | 259,667 | 0.050 | 0.211 | 0.317 | 33 | 838 | | | 1,480 | 860 | 25.30 | 21.66 | 22.26 | 18.62 | 2.00 | 2.00 | 0.80 | 0.443 | |
| 14 | 18 | 77.9 | 468.0 | 51,853 | 311,520 | 0.042 | 0.253 | 0.380 | 36 | 914 | | | 1,130 | 970 | 21.66 | 17.48 | 18.55 | 14.37 | 2.00 | 2.00 | 0.80 | 0.525 | |
| 15 | 16 | 0.0 | 0.0 | 0 | 0 | 0.000 | 0.000 | 0.000 | 27 | 686 | | | 1,480 | 660 | 27.00 | 24.30 | 24.11 | 21.41 | 2.00 | 2.00 | 0.80 | 0.296 | |
| 16 | 17 | 0.0 | 0.0 | 0 | 0 | 0.000 | 0.000 | 0.000 | 33 | 838 | | | 1,610 | 860 | 24.30 | 18.30 | 21.26 | 15.26 | 2.00 | 2.00 | 0.80 | 0.443 | |
| 17 | 18 | 0.0 | 0.0 | 0 | 0 | 0.000 | 0.000 | 0.000 | 42 | 1,067 | | | 1,470 | 1,190 | 18.30 | 17.48 | 13.03 | 11.80 | 4.00 | 4.42 | 0.80 | 0.717 | |
| 18 | 19 | 61.7 | 529.7 | 41,070 | 352,590 | 0.033 | 0.287 | 0.430 | 54 | 1,372 | | | 980 | 1,670 | 17.48 | 18.12 | 10.49 | 9.90 | 5.42 | 6.64 | 0.80 | 1.183 | |
| 19 | 24 | 17.9 | 1,400.1 | 11,915 | 931,964 | 0.010 | 0.758 | 1.137 | 84 | 2,134 | | | 890 | 3,000 | 18.12 | 18.70 | 9.14 | 8.84 | 6.64 | 7.52 | 0.80 | 2.865 | |
| 20 | 21 | 76.6 | 76.6 | 50,988 | 50,988 | 0.041 | 0.041 | 0.062 | 15 | 381 | | | 940 | 300 | 33.43 | 28.69 | 30.85 | 26.11 | 2.00 | 2.00 | 0.80 | 0.092 | |
| 21 | 22 | 236.7 | 313.3 | 157,557 | 208,545 | 0.128 | 0.170 | 0.254 | 30 | 762 | | | 1,630 | 760 | 28.69 | 23.84 | 25.73 | 20.88 | 2.00 | 2.00 | 0.80 | 0.366 | |
| 22 | 23 | 208.5 | 521.8 | 138,786 | 347,332 | 0.113 | 0.283 | 0.424 | 42 | 1,067 | | | 810 | 1,190 | 23.84 | 25.67 | 18.57 | 17.89 | 4.00 | 6.51 | 0.80 | 0.717 | |
| 23 | 24 | 127.9 | 649.7 | 85,135 | 432,467 | 0.069 | 0.352 | 0.528 | 48 | 1,219 | | | 1,610 | 1,420 | 25.67 | 18.70 | 17.74 | 13.28 | 6.51 | 4.00 | 0.80 | 0.936 | |
| 24 | 26 | 246.3 | 2,296.1 | 163,947 | 1,528,378 | 0.133 | 1.243 | 1.865 | | 1,750 | 1,750 | 2 | 1,010 | 3,400 | 18.70 | 14.82 | 0.30 | 0.00 | 16.45 | 12.87 | 0.80 | 4.272 | |
| 25 | 26 | 76.6 | 76.6 | 50,988 | 50,988 | 0.041 | 0.041 | 0.062 | 18 | 457 | | | 480 | 380 | 14.41 | 14.82 | 10.75 | 9.49 | 3.00 | 4.67 | 0.81 | 0.132 | |
| 26 | 27 | 60.9 | 2,433.6 | 40,538 | 1,619,904 | 0.033 | 1.318 | 1.977 | 56, 66 | | | | | | | | | | | | | | Existing |
| 27 | 28 | | 2,433.6 | | 1,619,904 | 0.102 | 1.420 | 2.130 | 56, 66 | | | | | | | | | | | | | | Existing |
| 28 | 29 | | 2,433.6 | | 1,619,904 | | 1.420 | 2.130 | 56, 66 | | | | | | | | | | | | | | Existing |
| 29 | TP-1 | | 2,433.6 | | 1,619,904 | | 1.420 | 2.130 | 56, 66 | | | | | | | | | | | | | | Existing |
| **To TP-3** | | | | | | | | | | | | | | | | | | | | | | | |
| 30 | 31 | 125.8 | 125.8 | 83,738 | 83,738 | 0.068 | 0.068 | 0.102 | 24 | 610 | | | 1,560 | 560 | 29.77 | 26.65 | 26.96 | 23.84 | 2.00 | 2.00 | 0.81 | 0.235 | |
| 31 | 32 | 62.6 | 188.4 | 41,669 | 125,407 | 0.034 | 0.102 | 0.153 | 24 | 610 | | | 1,690 | 560 | 26.65 | 21.90 | 23.84 | 19.09 | 2.00 | 2.00 | 0.81 | 0.235 | |
| 32 | Gujjar Nallah | 31.6 | 220.0 | 21,034 | 146,441 | 0.017 | 0.119 | 0.179 | 27 | 686 | | | 810 | 660 | 21.90 | 21.90 | 19.01 | 17.79 | 2.00 | 3.23 | 0.80 | 0.296 | |
| 33 | 34 | 126.9 | 126.9 | 84,470 | 84,470 | 0.069 | 0.069 | 0.103 | 24 | 610 | | | 860 | 560 | 17.48 | 13.89 | 14.67 | 11.08 | 2.00 | 2.00 | 0.81 | 0.235 | |
| 34 | Lyari Iterceptor | 129.4 | 256.3 | 86,134 | 170,604 | 0.070 | 0.139 | 0.208 | 27 | 686 | | | 870 | 660 | 13.89 | 9.89 | 11.00 | 7.00 | 2.00 | 2.00 | 0.80 | 0.296 | |
| **To Gujjar Nallah** | | | | | | | | | | | | | | | | | | | | | | | |
| (1) Right Bank Side | | 180.0 | | 119,815 | | 0.097 | | | | | | | | | | | | | | | | | |
| (2) Left Bank Side | | 41.6 | 221.6 | 27,691 | 147,506 | 0.023 | 0.120 | | | | | | | | | | | | | | | | |
| **To Lyari Interceptor** | | | | | | | | | | | | | | | | | | | | | | | |
| (1) Gulberg Town | | 863.2 | | 574,581 | | 0.467 | | | | | | | | | | | | | | | | | |
| (2) Liaquatabad Town | | 145.4 | 1,008.6 | 96,784 | 671,366 | 0.079 | 0.546 | | | | | | | | | | | | | | | | |

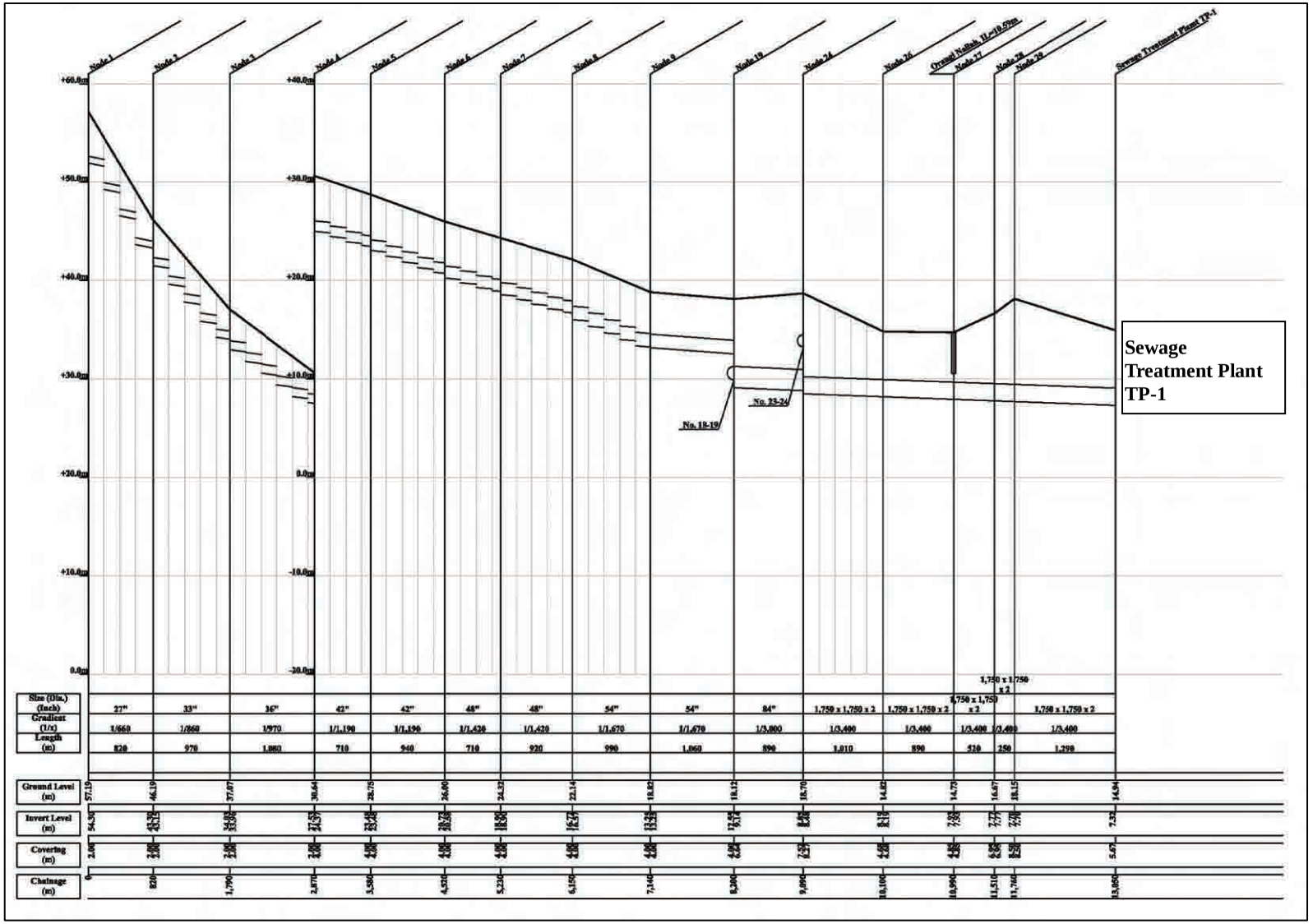



**Figure A124.4 Longitudinal Section of Trunk Sewer and Sub-main Sewer (1/4)**

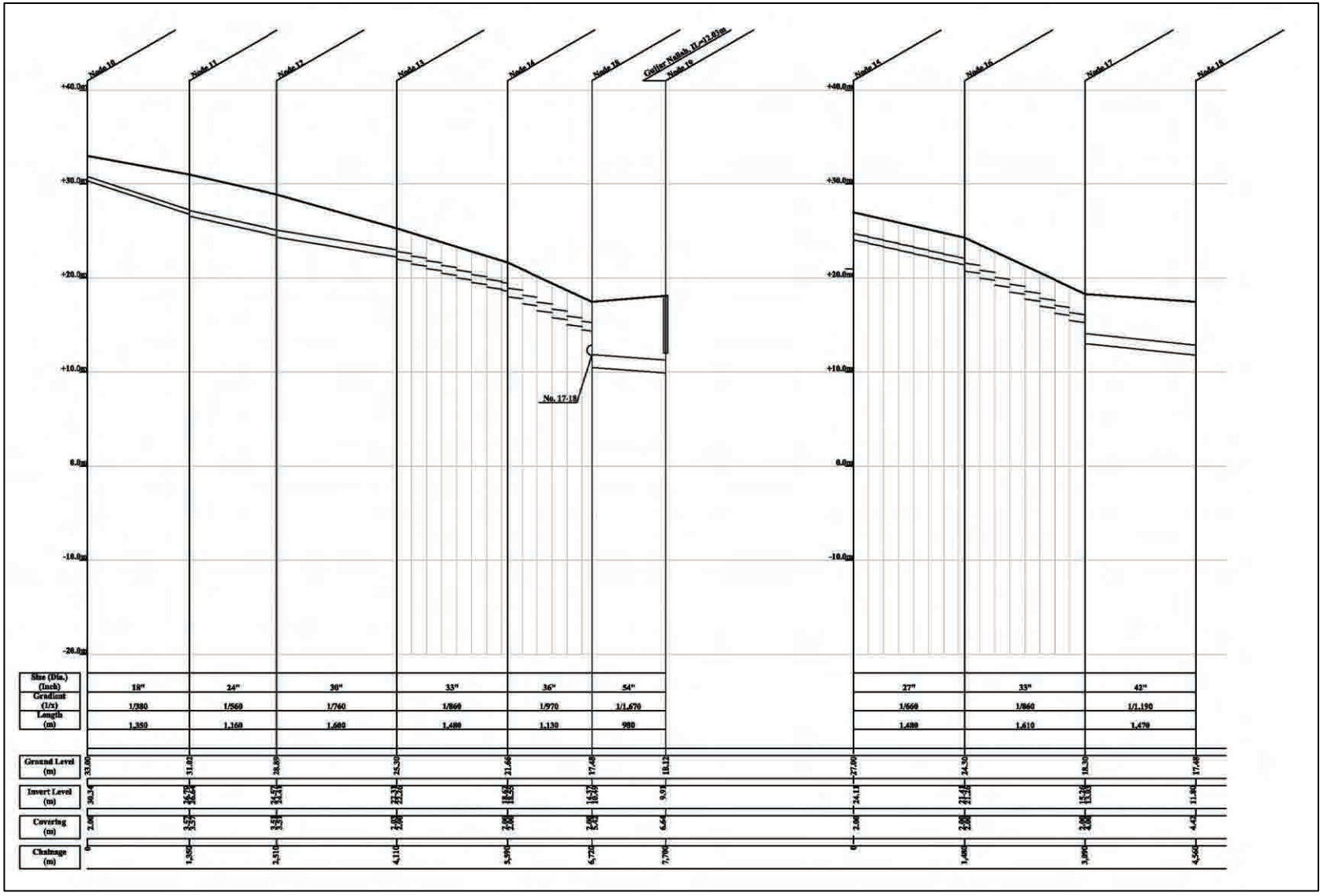



**Figure A124.5 Longitudinal Section of Trunk Sewer and Sub-main Sewer (2/4)**

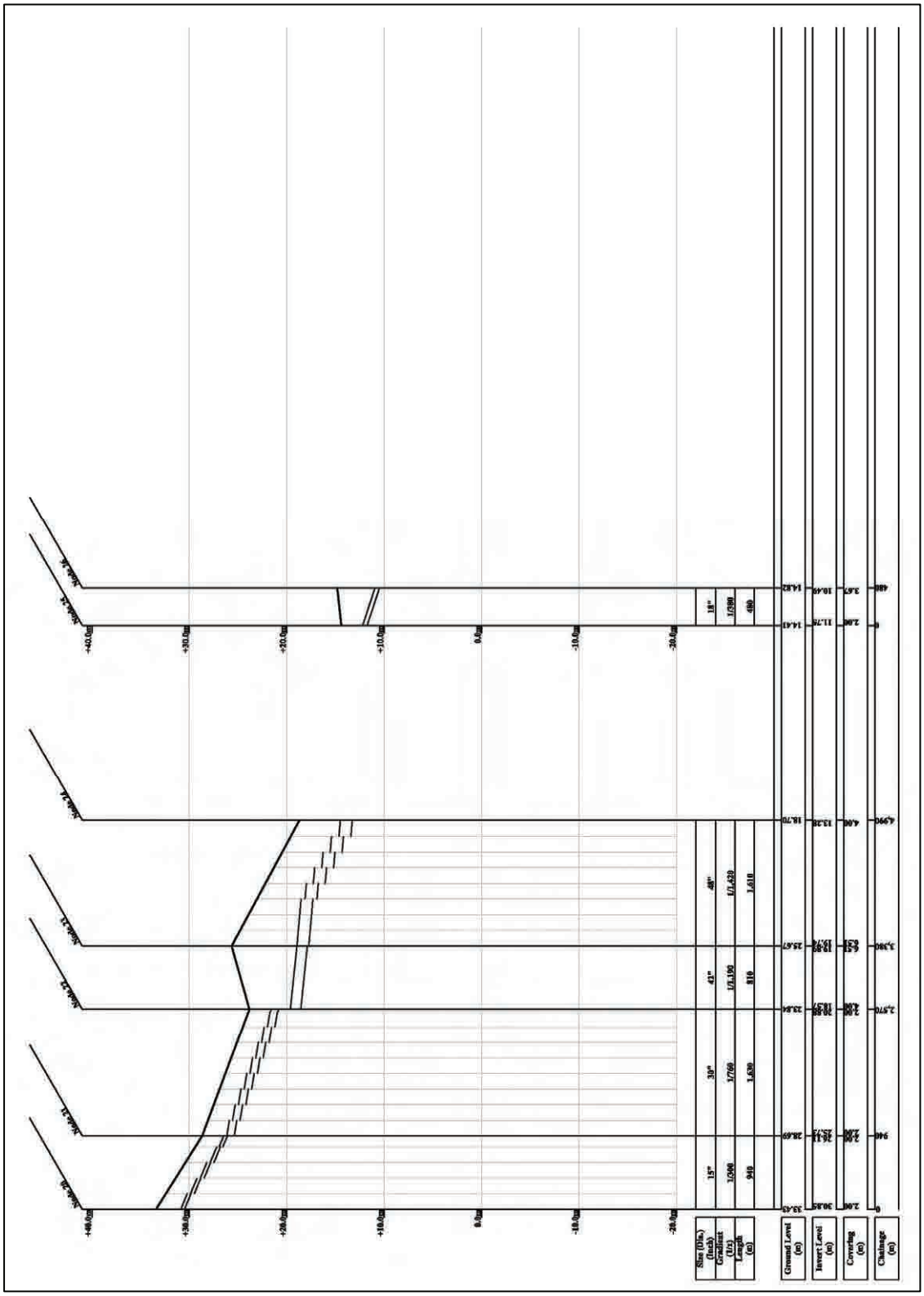


**Figure A124.6 Longitudinal Section of Trunk Sewer and Sub-main Sewer (3/4)**

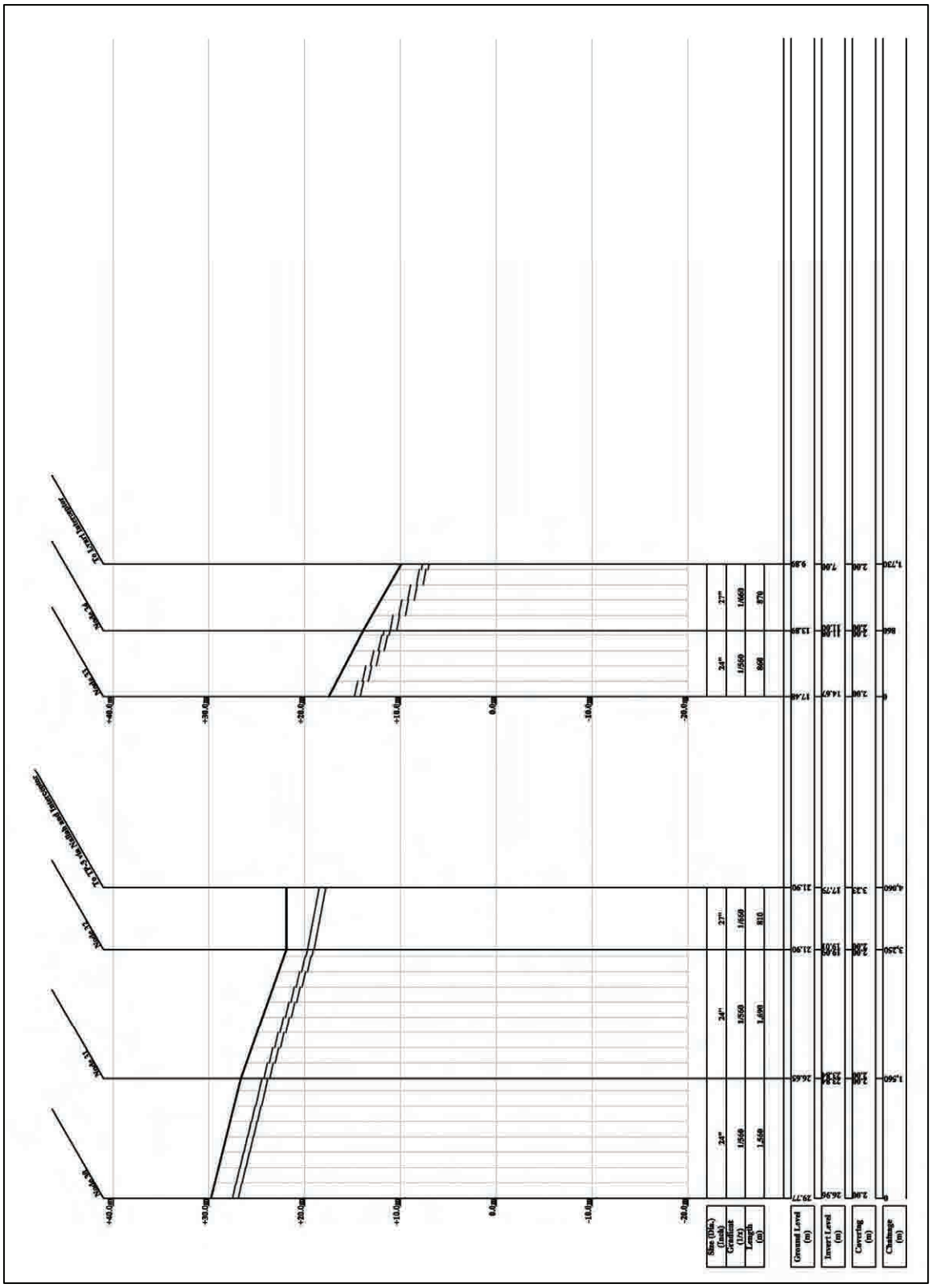


**Figure A124.7 Longitudinal Section of Trunk Sewer and Sub-main Sewer (4/4)**

# APPENDIX – A124.2

## Rehabilitation of Sewage Treatment Plants

## A124.2 Rehabilitation of Sewage Treatment Plants

### (1) TP-1

### a) Main Pumping Station

**Figure A124.2.1** shows the flow diagram of pumping station. This pumping station equipment consists of main pump, bar screen, ventilation fan, sump pump, control panel and level meter etc. This pumping station is barely functioning with the effort of good maintenance but damaged by stain, rust, corrosion. Moreover level meters are not working at all. In order to recover its function, almost all the equipment needs rehabilitation.

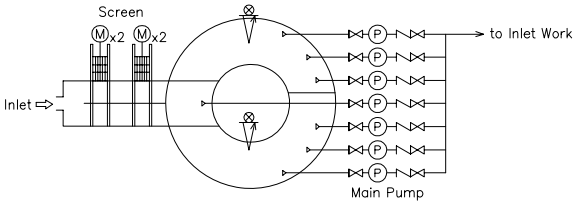



**Figure A124.2.1 Flow Diagram of Pumping Station at TP-1**

### b) Screen, Grit Chamber, Partial Flume

**Figure A124.2.2** shows the flow diagram of inlet works. The motors of screen, detritor, grit collector and control panels are in bad condition. Therefore, those motors and panels shall be replaced with new ones.

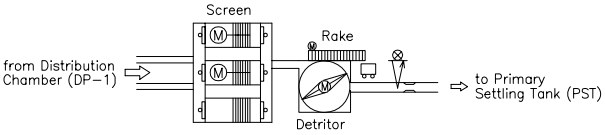



**Figure A124.2.2 Flow Diagram of Inlet Works at TP-1**

### c) Primary Settling Tank

Sludge collectors for PST are in bad condition. They need to be replaced.

### d) Trickling Filter

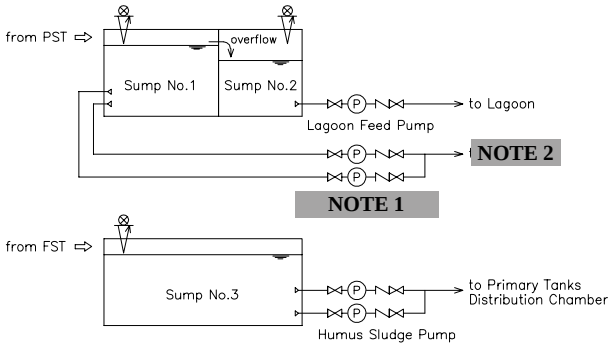
Trickling filters are in bad condition. They need to be replaced.

### e) Final Settling Tank

Sludge collectors for FST are in bad condition. They need to be replaced.

### f) Sludge Pumping Station No.1 at Train 1

**Figure A124.2. 3** shows the flow diagram of sludge pumping station No.1. All the equipments are not working. They shall be replaced.




NOTE 1)
Before Rehabilitation : **Digester Feed Pump**
After Rehabilitation : **Lagoon Feed Pump**

NOTE 2)
Before Rehabilitation : **to Digester**
After Rehabilitation : **to Lagoon**

**Figure A124.2.3 Flow Diagram of Sludge Pumping Station No.1 at TP-1**

**g) Sludge Pumping Station No.2 at Train 2**

**Figure A124.2.4** shows the flow diagram of sludge pumping station No.2. All the equipments are not working. They shall be replaced.

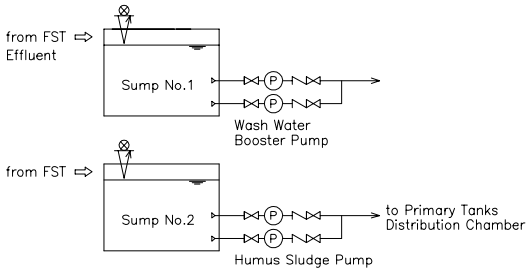



**Figure A124.2.4 Flow Diagram of Sludge Pumping Station No.2 at TP-1**

**h) Sludge Digester**

Sludge digesters are not working. They shall be abandoned.

**i) Sludge Drying Lagoon**

Some pipes are damaged. Therefore some piping works are required.

**j) Generator**

Generators are not working. They shall be replaced.

**k) SubStation**

Switchboard and transformer are in bad condition. They need to be replaced. **Figure A124.2.5** shows proposed power distribution diagram.

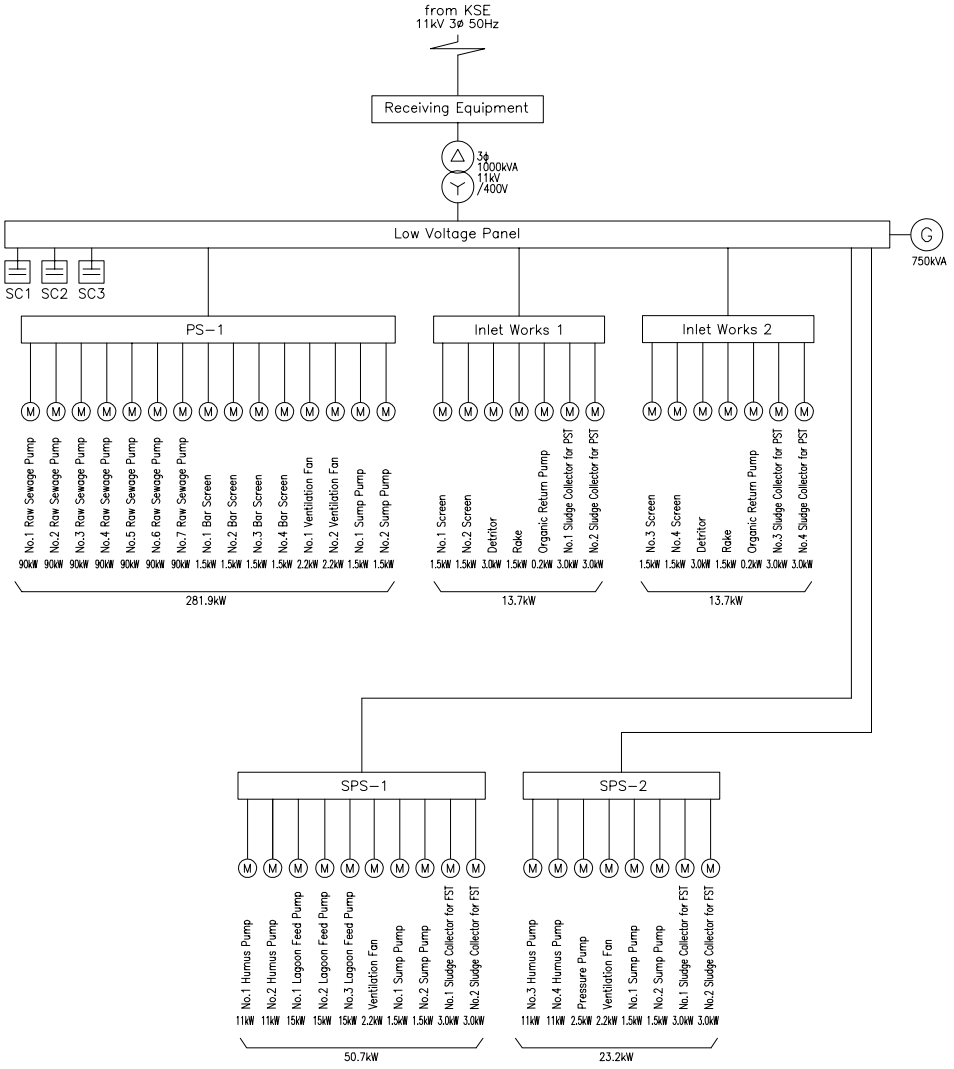



**Figure A124.2.5 Proposed Power Distribution Diagram TP-1**

**l) Piping Work**

Some pipes are damaged. Therefore some piping works are required.

**(2) TP-3**

**a) Main Pumping Station**

Coase screen motor and local control switch box are in bad condition. They need to be replaced.

**b) Gravity Channel**

They are in good condition.

**c) Screen, Grit Chamber**

**Figure A124.2.6** shows the flow diagram of screen and grit chamber. The motors of screen, detritor, grit collector and control panels are in bad condition. Therefore, those motors and panels shall be replaced with new ones.

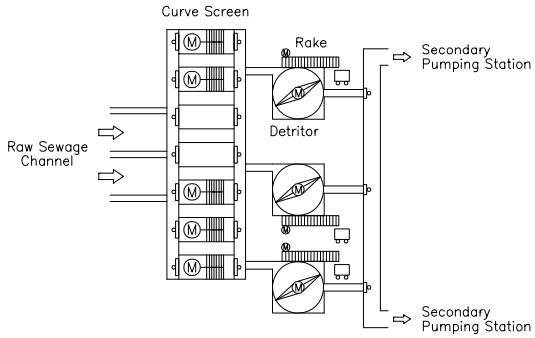



**Figure A124.2.6 Flow Diagram of Screen and Grit Chamber at TP-3**

**d) Anaerobic Pond**

Secondary pumps are in bad condition. These submergeble pumps shall be replaced with vertical type for easer maintainability. **Figure A124.2.7** shows the flow diagram of proposed secondary pump. **Figure A124.2.11 and 12** shows the layout of proposed secondary pumping station.

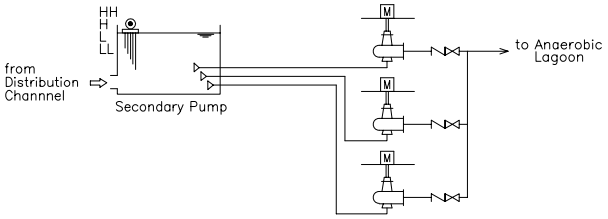



**Figure A124.2.7 Flow Diagram of Proposed Secondary Pump at TP-3**

**e) Facultative Pond**

They are in good condition.

**f) Drying Beds**

They are in good condition.

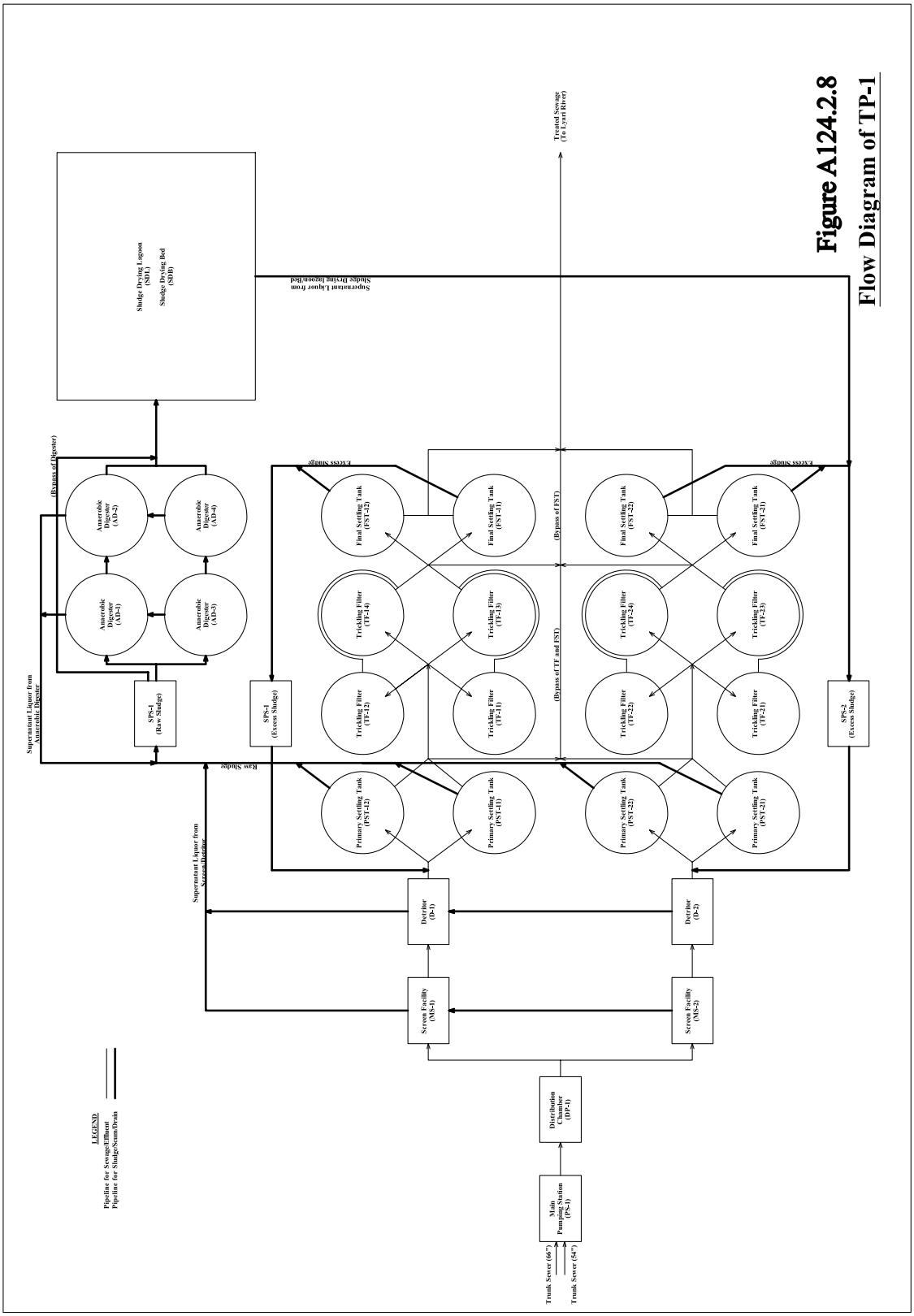
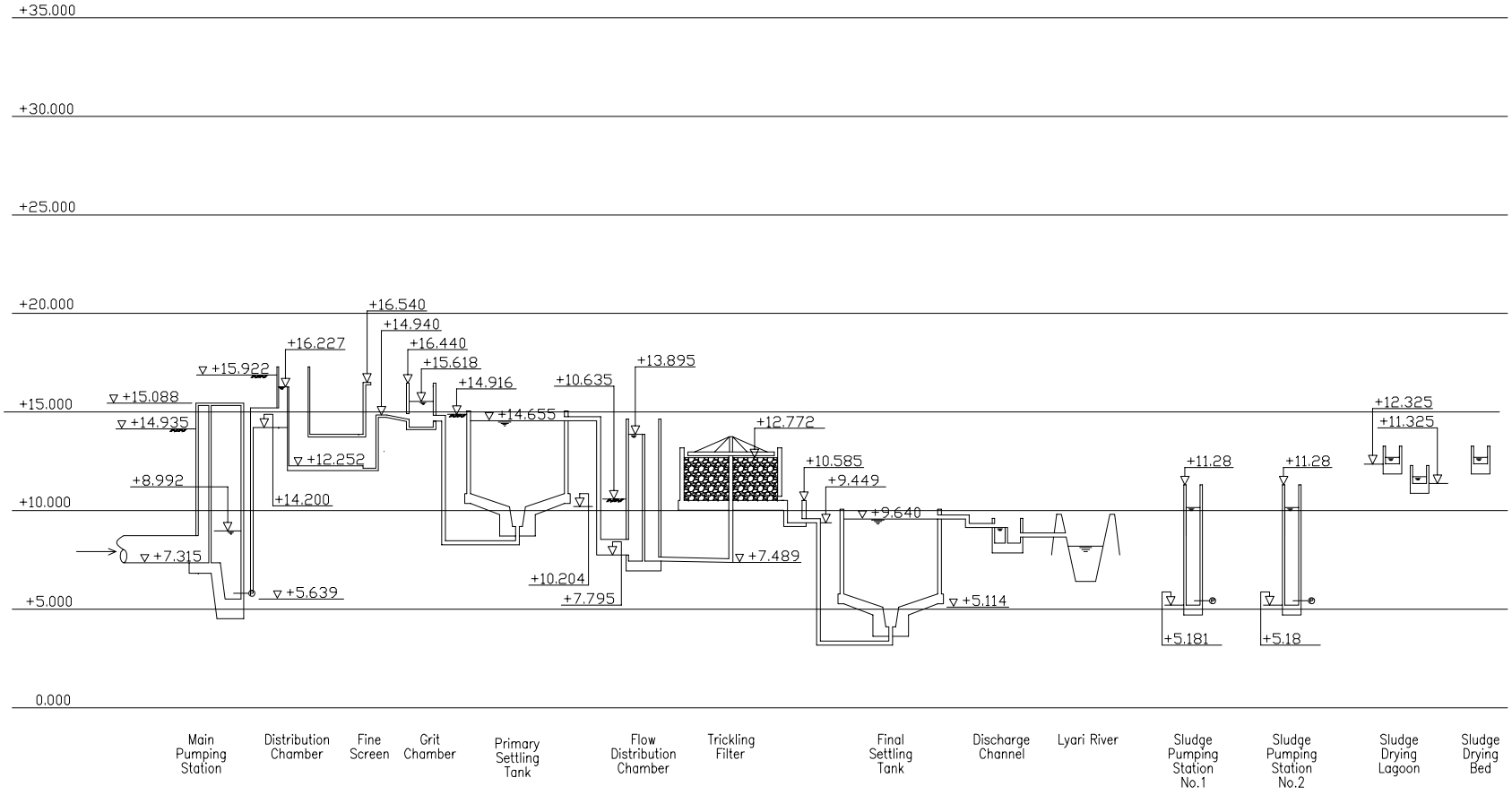


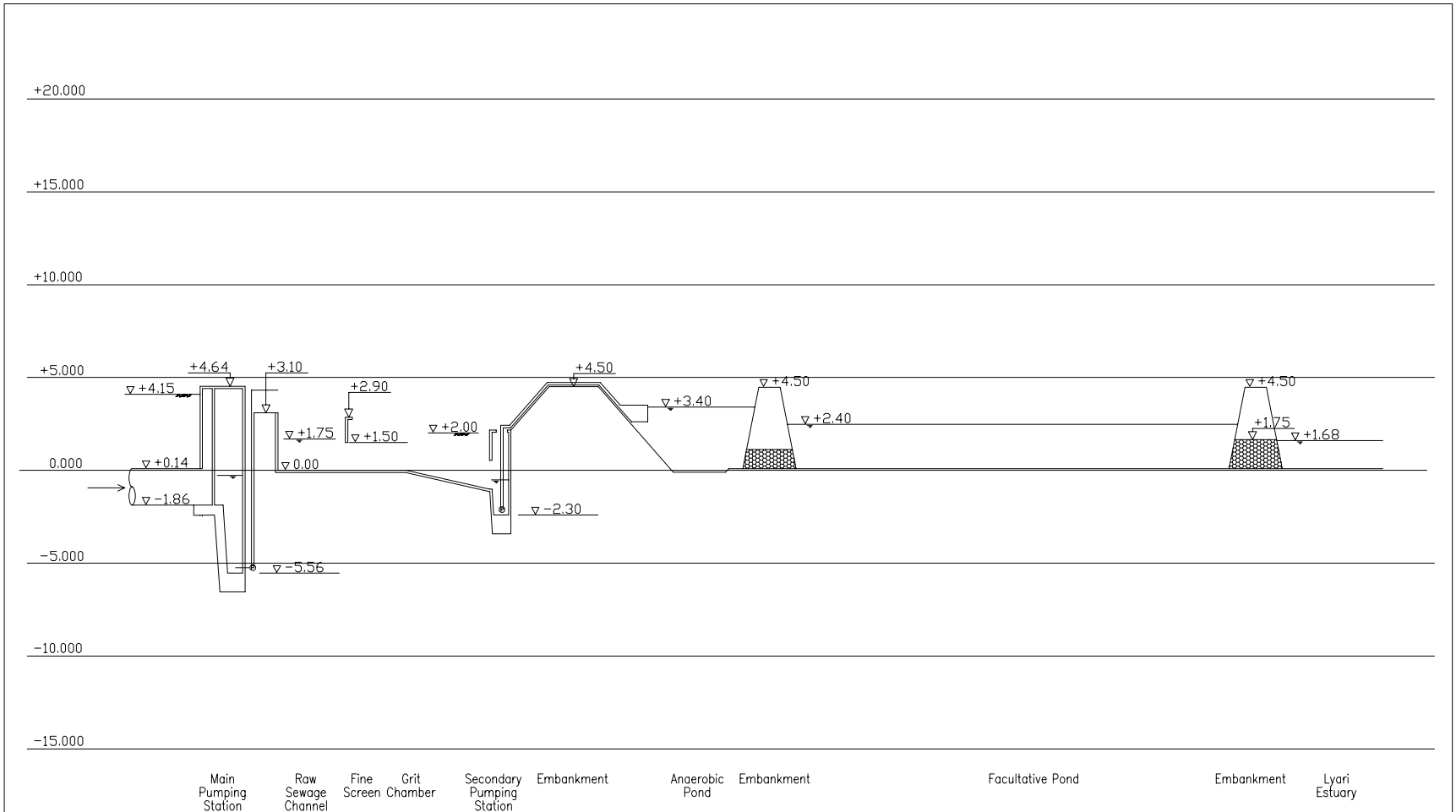

**Figure A124.2.8**

**Flow Diagram of TP-1**




**Hydraulic Flow Diagram TP-1**

**Fig. A124.2.9**




**Hydraulic Flow Diagram TP-3**

**Fig. A124.2.10**

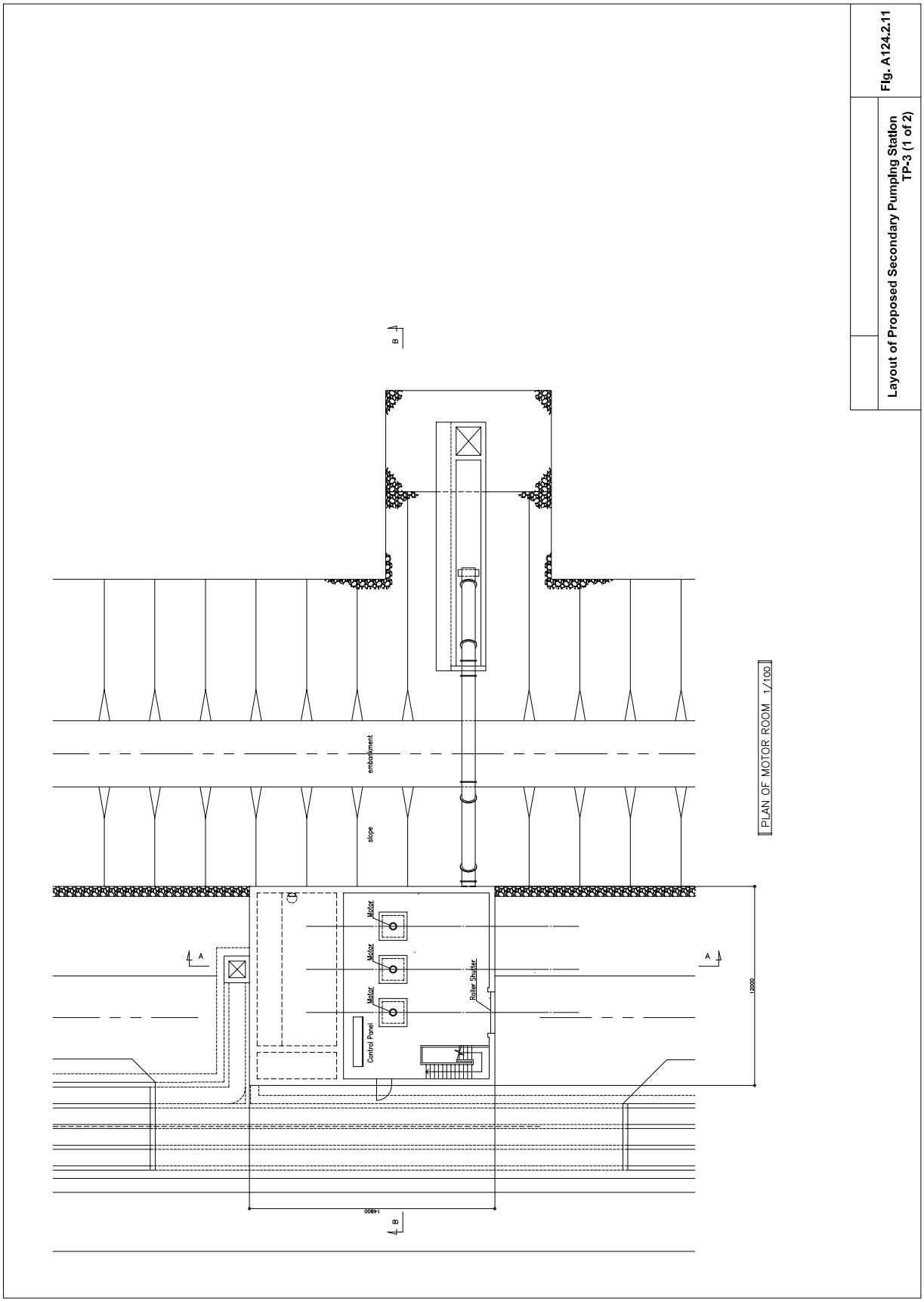
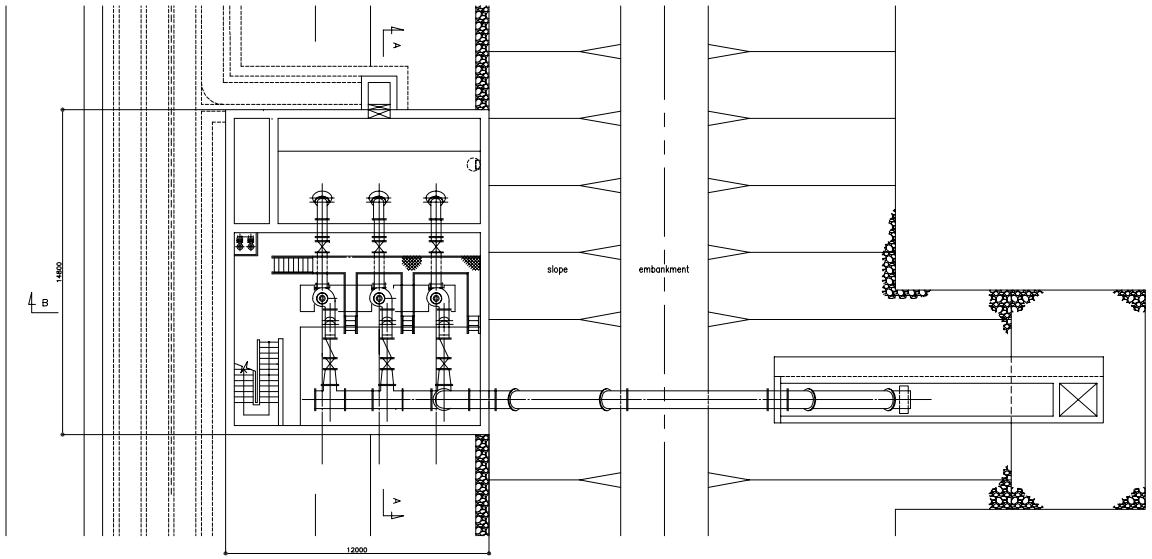
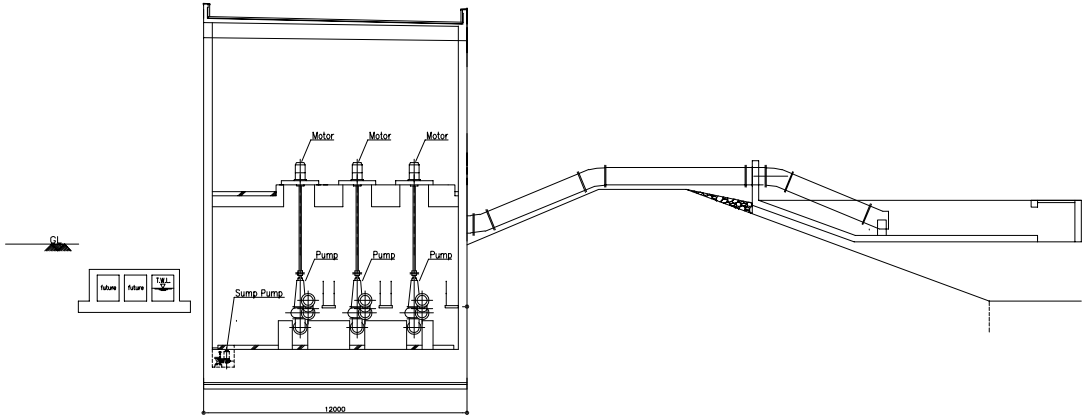


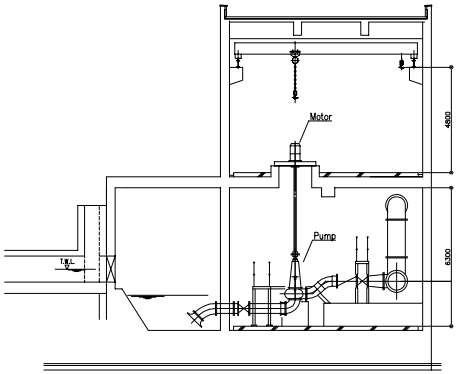
Fig. A124.2.11
Layout of Proposed Secondary Pumpling Station
TP-3 (1 of 2)
PLAN OF MOTOR ROOM 1/100
embankment
slope
Motor
Motor
Motor
Roller Shutter
Control Panel
A
B
12000
14800




PLAN OF PUMP ROOM 1/100




SECTION B–B 1/100




SECTION A–A 1/100

| | | |
|---|---|---|
| | Layout of Proposed Secondary Pumping Station<br>TP-3 (2 of 2) | Fig. A124.2.12 |

# APPENDIX – A124.3

## Sewerage Facilities Improvement Plan

## A124.3 Sewerage Facilities Improvement Plan

| NO | DESCRIPTION | COMMENT |
|---|---|---|
| 1 | Improve safety standards | Introduce safe systems of work for plant isolation (lock-off/tag-out procedures when working on moving or electrical equipment)<br><br>Improve plant safety such as railing of open channels, testing of lifting tackle, guarding of moving equipment/shafts etc.<br><br>Improve safety awareness, staff training and issue PPE<br>Provide appropriate spark proof tools and flame proof equipment for working in potentially explosive atmospheres at TPs, PSs and in sewers<br><br>Provide gas detection equipment and forced air ventilation where necessary such as in PSs and before entering sewers, wet wells etc.<br><br>Upgrade all facilities to ensure compliance with relevant regulations in force for electrical installations in potentially explosive atmospheres<br><br>Provide basic tools for safe working in the highways such as reflective jackets, signage, safety lighting and manhole cover keys |
| 2 | Install meters at the inlet to TPs | Use good quality electromagnetic or ultrasonic flow meters that comply with international standards |
| 3 | Develop and implement Best Practice Operating Manuals for plants, pumping stations and sewers | These will be used for training purposes and to ensure that standard operating procedures are followed |
| 4 | Provide appropriate tools for cleaning and unblocking sewers | These can be hand tools as well as power tools such as cleaning rods, swabs, gully suckers etc. Implement program of regular cleaning and maintenance or contract out these services |
| 5 | Develop plant criticality assessment model | Assign criticality levels to key plant and equipment |
| 6 | Develop and implement planned maintenance schedules | Carry out tasks accordingly including lubrication schedules |
| 7 | Replace all defective or missing manhole covers | Ensure manholes covers meet the required standards and are inspected regularly |
| 8 | Prepare Strategic sewer plans | Digitise all sewer networks starting with the strategic sewers and consider systematic rehabiltation of inadequate or defective sewers |
| 9 | Introduce a system of key performance measures | Monitor performance against agreed targets for each team/division/region |
| 10 | Ensure that all Contractors are 'qualified' (certified) to work on sewers both existing and new | Introduce a system of contractor certification or accreditation, set appropriate standards of repair and enforce standards |
| 11 | Ensure trade effluent compliance | Set up a system for regular visits to all trade effluent companies discharging to sewers. Ensure compliance with effluent standards, installation/cleaning of fat traps etc. |
| 12 | Implement systems for recording asset and maintenance data | Computerise the capture of asset and maintenance data and implement system of planned preventative maintenance (CMMS) |
| 13 | Introduce system of performance management and key Performance Indicators (PI) in accordance with 'balanced scorecard' | Measure performance against standards |
| 14 | Develop staff competencies to meet current and future technological improvements such as | Buy in skills where development is not possible |

| NO | DESCRIPTION | COMMENT |
|---|---|---|
| | computer, instrumentation, PLC, telemetry skills | |
| 15 | Introduce a system for continuous process reviews to ensure that all treatment processes conform to agreed quality standards at least cost. | Will require some process re-engineering |
| 16 | Introduce a system to capture spatial information. | Use of Geographical Information System (GIS) as well as other systems for asset management such as a computerised maintenance management system (CMMS) |

# APPENDIX – A125.1

## Preliminary Cost Estimates

## A125.1 Preliminary Cost Estimates

### Table A125.1.1 Construction Cost of Water Supply System

(unit: Rs.thousand)

| No. | Components | Description | Quantity | Unit | Amount | Foreign C. | Local C. |
|---|---|---|---|---|---|---|---|
| | | | | | | 80% | 20% |
| 1 | **Reservoir** | 30Mg | 1 | l.s. | 490,860 | 392,688 | 98,172 |
| 2 | **Trunk Distribution Main** | | | | | | |
| | | | | | | 70% | 30% |
| | a) New Installation | DN16 - DN100inch L=25,990 m | 1 | l.s. | 2,214,780 | 1,550,346 | 664,434 |
| | | | | | | 70% | 30% |
| | b) Rehabilitation/Replacement | DN14 - DN64inch L=49,490 m | 1 | l.s. | 2,391,200 | 1,673,840 | 717,360 |
| | | | | | | 70% | 30% |
| | Total (2) | L=75,480m | | | 4,605,980 | 3,224,186 | 1,381,794 |
| | | | | | | 100% | 0% |
| 3 | **Flow Meter** | Electromagnetic Type DN18 - DN100inch N=17nos. | 1 | l.s. | 46,125 | 46,125 | 0 |
| 4 | **Distribution Network Main** | | | | | | |
| | | | | | | 70% | 30% |
| | a) North Nazimabad | L=336,600m | 1 | l.s. | 1,009,800 | 706,860 | 302,940 |
| | | | | | | 70% | 30% |
| | b) Gulberg | L=374,900m | 1 | l.s. | 1,124,700 | 787,290 | 337,410 |
| | | | | | | 70% | 30% |
| | c) Liaquatabad | L=284,600m | 1 | l.s. | 853,800 | 597,660 | 256,140 |
| | | | | | | 70% | 30% |
| | Total (4) | L=996,100m | | | 2,988,300 | 2,091,810 | 896,490 |
| 5 | **House Connection** | | | | | | |
| | **5.1 Water Meter only** | | | | | | |
| | | | | | | 100% | 0% |
| | a) North Nazimabad | N=8,880nos. | 1 | l.s. | 15,840 | 15,840 | 0 |
| | | | | | | 100% | 0% |
| | b) Gulberg | N=9,200nos. | 1 | l.s. | 16,560 | 16,560 | 0 |
| | | | | | | 100% | 0% |
| | d) Liaquatabad | N=2,100nos | 1 | l.s. | 3,780 | 3,780 | 0 |
| | | | | | | 100% | 0% |
| | Total (5.1) | N=20,100nos. | | | 36,180 | 36,180 | |
| | **5.2 Water Meter and Service Pipes** | | | | | | |
| | | | | | | 81% | 19% |
| | a) North Nazimabad | N=68,600nos. | 1 | l.s. | 329,280 | 266,717 | 62,563 |
| | | | | | | 81% | 19% |
| | b) Gulberg | N=71,500nos. | 1 | l.s. | 343,200 | 277,992 | 65,208 |
| | | | | | | 81% | 19% |
| | c) Liaquatabad | N=68,100nos. | 1 | l.s. | 326,880 | 264,773 | 62,107 |
| | | | | | | 81% | 19% |
| | Total (5.2) | N=208,200nos. | | | 999,360 | 809,482 | 189,878 |
| | | | | | | 82% | 18% |
| | Total (5) | N=228,300nos. | | | 1,035,540 | 845,662 | 189,878 |
| | | | | | | 72% | 28% |
| | Total (1-5) | | | | 9,166,805 | 6,600,471 | 2,566,334 |
| | | | | | | 70% | 30% |
| 6 | **Engineering Fee** | F/C Total(1-5)×7.5%, L/C Total(1-5)×7.5% | 1 | l.s. | 687,510 | 481,257 | 206,253 |
| | | | | | | 0% | 100% |
| 7 | **Land Acquisition** | | 1 | l.s. | 3,680 | 0 | 3,680 |
| | | | | | | 72% | 28% |
| 8 | **Physical Contingency** | F/C Total(1-7)×5.0%, L/C Total(1-7)×5.0% | 1 | l.s. | 492,899 | 354,086 | 138,813 |
| | | | | | | 36% | 64% |
| 9 | **Price Contingency** | F/C Total(1-8)×1.5%, L/C Total(1-8)×6.0% | 1 | l.s. | 1,916,802 | 694,906 | 1,221,896 |
| | | | | | | 0% | 100% |
| 10 | **Project Administration** | F/C Total(1-9)×1.5%, L/C Total(1-9)×1.5% | 1 | l.s. | 184,015 | 0 | 184,015 |
| | | | | | | 47% | 53% |
| | Total (6-10) | | | | 3,284,906 | 1,530,249 | 1,754,657 |
| | | | | | | 65% | 35% |
| | Total (1-10) | | | | 12,451,711 | 8,130,720 | 4,320,991 |

## Table A125.1.2 Construction Cost of Sewerage System

(Unit: Rs.thousand)

| No. | Components | Description | Quantity | Unit | Amount | Foreign C. | Local C. |
|---|---|---|---|---|---|---|---|
| 1 | **TP-1 Sewage Treatment Plant** | | | | | | |
| | **1.1 Mechanical Equipment** | | | | | | |
| | | | | | | 90% | 10% |
| | a) Main Pumping Station | Vertical1 Centrifugal, 31.2$m^3$/min 10.0m 90kw | 1 | l.s. | 40,866 | 36,780 | 4,086 |
| | | | | | | 90% | 10% |
| | b) Screen Chamber | Drive Equipment for Mechanical Rake 1.5kw | 1 | l.s. | 110 | 99 | 11 |
| | | | | | | 90% | 10% |
| | c) Detritor | Drive Equipment for Grit Collector Rake 3.0kw | 1 | l.s. | 188 | 170 | 18 |
| | | | | | | 90% | 10% |
| | d) Primary Settling Tank | Equipment of Sludge Collector Rake Diameter 42.0m | 1 | l.s. | 25,300 | 22,770 | 2,530 |
| | | | | | | 90% | 10% |
| | e) Trickling Filter | Water Spray Bar Diameter 41.4m | 1 | l.s. | 50,600 | 45,540 | 5,060 |
| | | | | | | 90% | 10% |
| | f) Final Settling Tank | Equipment of Sludge Collector Rake Diameter 42.0m | 1 | l.s. | 25,300 | 22,770 | 2,530 |
| | | | | | | 90% | 10% |
| | g) Sludge Pump Station No.1 | Humus Sludge Pump, Lagoon Feed Pump | 1 | l.s. | 15,100 | 13,590 | 1,510 |
| | | | | | | 90% | 10% |
| | h) Sludge Pump Station No.2 | Humus Sludge Pump, Pressure Pump | 1 | l.s. | 7,970 | 7,173 | 797 |
| | | | | | | 90% | 10% |
| | Total (1.1) | | | | 165,434 | 148,892 | 16,542 |
| | | | | | | 90% | 10% |
| | **1.2 Electrical Equipment** | Transformer, Panel, Instrumentation, Generator | 1 | l.s. | 42,010 | 37,811 | 4,199 |
| | | | | | | 20% | 80% |
| | **1.3 Removal and Installation** | Mechanical and Electrical Equipment | 1 | l.s. | 81,174 | 16,235 | 64,939 |
| | | | | | | 70% | 30% |
| | **1.4 Internal pipe of Sewage Treatment Plant** | DN100 - DN300mm DN1,050mm L=4,870m | 1 | l.s. | 48,661 | 34,063 | 14,598 |
| | | | | | | 70% | 30% |
| | Total (1) | | | | 337,279 | 237,001 | 100,278 |
| 2 | **TP-3 Sewage Treatment Plant** | | | | | | |
| | **2.1 Mechanical Equipment** | | | | | | |
| | | | | | | 90% | 10% |
| | a) Main Pumping Station | Motor for Bar Screen 1.5kw | 1 | l.s. | 3,905 | 3,515 | 390 |
| | | | | | | 90% | 10% |
| | b) Screen Chamber | Drive Equipment for Mechanical Rake 1.5kw | 1 | l.s. | 138 | 124 | 14 |
| | | | | | | 90% | 10% |
| | c) Detritor | Drive Equipment for Grit Collector Rake 3.0kw | 1 | l.s. | 3,066 | 2,760 | 306 |
| | | | | | | 90% | 10% |
| | d) Anaerobic Pond | Secondary Pump, Vertical Pump 50$m^3$/min 7m 75kw | 1 | l.s. | 93,357 | 84,021 | 9,336 |
| | | | | | | 90% | 10% |
| | Total (2.1) | | | | 100,466 | 90,420 | 10,046 |
| | | | | | | 90% | 10% |
| | **2.2 Electrical Equipment** | Panel, Instrumentation | 1 | l.s. | 23,651 | 21,286 | 2,365 |
| | | | | | | 20% | 80% |
| | **2.3 Removal and Installation** | Mechanical and Electrical Equipment | 1 | l.s. | 48,568 | 9,714 | 38,854 |
| | | | | | | 25% | 75% |
| | **2.4 Pump House for Secondary Pump** | W=10.0m L=15.0m H=5.0m | 1 | l.s. | 26,000 | 6,500 | 19,500 |
| | | | | | | 64% | 36% |
| | Total (2) | | | | 198,685 | 127,920 | 70,765 |
| 3 | **Sewer and Box Culvert** | | | | | | |
| | **3.1 Branch Sewer** | | | | | | |
| | | | | | | 20% | 80% |
| | a) North Nazimabad Town | DN10 inch L=100,100m | 1 | l.s. | 350,350 | 70,070 | 280,280 |
| | | | | | | 20% | 80% |
| | b) Gulberg Town | DN10 inch L=86,700m | 1 | l.s. | 303,450 | 60,690 | 242,760 |
| | | | | | | 20% | 80% |
| | c) Liaquatabad Town | DN10 inch L=82,500m | 1 | l.s. | 288,750 | 57,750 | 231,000 |
| | | | | | | 20% | 80% |
| | Total (3.1) | L=269,300m | | | 942,550 | 188,510 | 754,040 |
| | **3.2 Trunk Sewer** | | | | | | |
| | | | | | | 20% | 80% |
| | a) North Nazimabad Town | DN12 - DN54inch L=20,620m | 1 | l.s. | 401,026 | 80,206 | 320,820 |
| | | | | | | 20% | 80% |
| | b) Gulberg Town | DN12 - DN33inch L=15,930m | 1 | l.s. | 247,322 | 49,464 | 197,858 |
| | | | | | | 20% | 80% |
| | c) North Nazimabad Town | DN12 - DN84inch, 1,750×1,750 Box Culvert L=17,440m | 1 | l.s. | 522,732 | 104,547 | 418,185 |
| | | | | | | 20% | 80% |
| | Total (3.2) | L=53,990m | | | 1,171,080 | 234,217 | 936,863 |
| | | | | | | 20% | 80% |
| | Total (3) | L=323,290m | | | 2,113,630 | 422,727 | 1,690,903 |
| | | | | | | 30% | 70% |
| | Total (1-3) | | | | 2,649,594 | 787,648 | 1,861,946 |
| | | | | | | 70% | 30% |
| 4 | **Engineering Fee** | F/C Total(1-3)×7.5%, L/C Total(1-3)×7.5% | 1 | l.s. | 198,720 | 139,104 | 59,616 |
| | | | | | | 33% | 67% |
| 5 | **Physical Contingency** | F/C Total(1-4)×5.0%, L/C Total(1-4)×5.0% | 1 | l.s. | 142,416 | 46,338 | 96,078 |
| | | | | | | 10% | 90% |
| 6 | **Price Contingency** | F/C Total(1-5)×1.5%, L/C Total(1-5)×6.0% | 1 | l.s. | 927,044 | 90,026 | 837,018 |
| | | | | | | 0% | 100% |
| 7 | **Project Administration** | F/C Total(1-6)×1.5%, L/C Total(1-6)×1.5% | 1 | l.s. | 58,767 | 0 | 58,767 |
| | | | | | | 21% | 79% |
| | Total (4-7) | | | | 1,326,947 | 275,468 | 1,051,479 |
| | | | | | | 27% | 73% |
| | Total (1-7) | | | | 3,976,541 | 1,063,116 | 2,913,425 |

# Table A125.1.3 Annual Construction Cost of Water Supply System (1/2)

| No. | Components | Description | Curr-ency | Ratio | Cost Rs.thousand | Year 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 25% | 50% | 25% | | |
| 1 | **Reservoir** | Capcity 30MG | - | 100% | 490,860 | 122,715 | 245,430 | 122,715 | | |
| | | | F/C | 80% | 392,688 | 98,172 | 196,344 | 98,172 | | |
| | | | L/C | 20% | 98,172 | 24,543 | 49,086 | 24,543 | | |
| 2 | **Trunk Distribution Main** | | | | | | | | | |
| | **2.1 New Installation** | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | |
| | DN 100 inch | L=9,620 m | - | 100% | 1,250,600 | 312,650 | 625,300 | 312,650 | | |
| | | | F/C | 70% | 875,420 | 218,855 | 437,710 | 218,855 | | |
| | | | L/C | 30% | 375,180 | 93,795 | 187,590 | 93,795 | | |
| | | | | | | 25% | 50% | 25% | | |
| | DN 88 inch | L=2,320 m | - | 100% | 245,920 | 61,480 | 122,960 | 61,480 | | |
| | | | F/C | 70% | 172,144 | 43,036 | 86,072 | 43,036 | | |
| | | | L/C | 30% | 73,776 | 18,444 | 36,888 | 18,444 | | |
| | | | | | | 50% | 50% | | | |
| | DN 72 inch | L=1,210 m | - | 100% | 99,220 | 49,610 | 49,610 | | | |
| | | | F/C | 70% | 69,454 | 34,727 | 34,727 | | | |
| | | | L/C | 30% | 29,766 | 14,883 | 14,883 | | | |
| | | | | | | | 50% | 50% | | |
| | DN 64 inch | L=30 m | - | 100% | 2,130 | | 1,065 | 1,065 | | |
| | | | F/C | 70% | 1,491 | | 746 | 746 | | |
| | | | L/C | 30% | 639 | | 320 | 320 | | |
| | | | | | | 25% | 50% | 25% | | |
| | DN 56 inch | L=3,830 m | - | 100% | 237,460 | 59,366 | 118,730 | 59,364 | | |
| | | | F/C | 70% | 166,222 | 41,556 | 83,111 | 41,555 | | |
| | | | L/C | 30% | 71,238 | 17,810 | 35,619 | 17,809 | | |
| | | | | | | 25% | 50% | 25% | | |
| | DN 48 inch | L=1,820 m | - | 100% | 100,100 | 25,026 | 50,050 | 25,024 | | |
| | | | F/C | 70% | 70,070 | 17,518 | 35,035 | 17,517 | | |
| | | | L/C | 30% | 30,030 | 7,508 | 15,015 | 7,507 | | |
| | | | | | | 25% | 50% | 25% | | |
| | DN 36 inch | L=3,120 m | - | 100% | 140,400 | 35,100 | 70,200 | 35,100 | | |
| | | | F/C | 70% | 98,280 | 24,570 | 49,140 | 24,570 | | |
| | | | L/C | 30% | 42,120 | 10,530 | 21,060 | 10,530 | | |
| | | | | | | 50% | 50% | | | |
| | DN 32 inch | L=10 m | - | 100% | 420 | 210 | 210 | | | |
| | | | F/C | 70% | 294 | 147 | 147 | | | |
| | | | L/C | 30% | 126 | 63 | 63 | | | |
| | | | | | | 50% | 50% | | | |
| | DN 28 inch | L=90 m | - | 100% | 3,510 | 1,756 | 1,754 | | | |
| | | | F/C | 70% | 2,457 | 1,229 | 1,228 | | | |
| | | | L/C | 30% | 1,053 | 527 | 526 | | | |
| | | | | | | | 50% | 50% | | |
| | DN 24 inch | L=1,360 m | - | 100% | 50,320 | | 25,160 | 25,160 | | |
| | | | F/C | 70% | 35,224 | | 17,612 | 17,612 | | |
| | | | L/C | 30% | 15,096 | | 7,548 | 7,548 | | |
| | | | | | | | 50% | 50% | | |
| | DN 18 inch | L=2,140 m | - | 100% | 70,620 | | 35,310 | 35,310 | | |
| | | | F/C | 70% | 49,434 | | 24,717 | 24,717 | | |
| | | | L/C | 30% | 21,186 | | 10,593 | 10,593 | | |
| | | | | | | | 50% | 50% | | |
| | DN 16 inch | L=440 m | - | 100% | 14,080 | | 7,040 | 7,040 | | |
| | | | F/C | 70% | 9,856 | | 4,928 | 4,928 | | |
| | | | L/C | 30% | 4,224 | | 2,112 | 2,112 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Total (2.1) | L=25,990 m | - | 100% | 2,214,780 | 545,198 | 1,107,389 | 562,193 | | |
| | | | F/C | 70% | 1,550,346 | 381,638 | 775,173 | 393,536 | | |
| | | | L/C | 30% | 664,434 | 163,560 | 332,217 | 168,658 | | |
| | **2.2 Rehabilitation/Replacement** | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | |
| | DN 64 inch | L=4,180 m | - | 100% | 296,780 | 74,196 | 148,390 | 74,194 | | |
| | | | F/C | 70% | 207,746 | 51,937 | 103,873 | 51,936 | | |
| | | | L/C | 30% | 89,034 | 22,259 | 44,517 | 22,258 | | |
| | | | | | | 25% | 50% | 25% | | |
| | DN 56 inch | L=4,660 m | - | 100% | 288,920 | 72,230 | 144,460 | 72,230 | | |
| | | | F/C | 70% | 202,244 | 50,561 | 101,122 | 50,561 | | |
| | | | L/C | 30% | 86,676 | 21,669 | 43,338 | 21,669 | | |
| | | | | | | 25% | 50% | 25% | | |
| | DN 48 inch | L=19,160 m | - | 100% | 1,053,800 | 263,450 | 526,900 | 263,450 | | |
| | | | F/C | 70% | 737,660 | 184,415 | 368,830 | 184,415 | | |
| | | | L/C | 30% | 316,140 | 79,035 | 158,070 | 79,035 | | |
| | | | | | | 50% | 50% | | | |
| | DN 32 inch | L=1,030 m | - | 100% | 43,260 | 21,630 | 21,630 | | | |
| | | | F/C | 70% | 30,282 | 15,141 | 15,141 | | | |
| | | | L/C | 30% | 12,978 | 6,489 | 6,489 | | | |
| | | | | | | 25% | 50% | 25% | | |
| | DN 24 inch | L=10,550 m | - | 100% | 390,350 | 97,587 | 195,176 | 97,587 | | |
| | | | F/C | 70% | 273,245 | 68,311 | 136,623 | 68,311 | | |
| | | | L/C | 30% | 117,105 | 29,276 | 58,553 | 29,276 | | |
| | | | | | | 25% | 50% | 25% | | |
| | DN 18 inch | L=4,210 m | - | 100% | 138,930 | 34,733 | 69,466 | 34,731 | | |
| | | | F/C | 70% | 97,251 | 24,313 | 48,626 | 24,312 | | |
| | | | L/C | 30% | 41,679 | 10,420 | 20,840 | 10,419 | | |
| | | | | | | | 50% | 50% | | |
| | DN 16 inch | L=2,460 m | - | 100% | 78,720 | | 39,360 | 39,360 | | |
| | | | F/C | 70% | 55,104 | | 27,552 | 27,552 | | |
| | | | L/C | 30% | 23,616 | | 11,808 | 11,808 | | |
| | | | | | | | 50% | 100% | | |
| | DN 14 inch | L=3,240 m | - | 100% | 100,440 | | 50,220 | 50,220 | | |
| | | | F/C | 70% | 70,308 | | 35,154 | 35,154 | | |
| | | | L/C | 30% | 30,132 | | 15,066 | 15,066 | | |
| | | | | | | 24% | 50% | 26% | | |
| | Total (2.2) | L=49,490 m | - | 100% | 2,391,200 | 563,826 | 1,195,602 | 631,772 | | |
| | | | F/C | 70% | 1,673,840 | 394,678 | 836,921 | 442,241 | | |
| | | | L/C | 30% | 717,360 | 169,148 | 358,681 | 189,531 | | |
| | | | | | | 24% | 50% | 26% | | |
| | Total (2) | L=75,480 m | - | 100% | 4,605,980 | 1,109,024 | 2,302,991 | 1,193,965 | | |
| | | | F/C | 70% | 3,224,186 | 776,316 | 1,612,094 | 835,777 | | |
| | | | L/C | 30% | 1,381,794 | 332,708 | 690,898 | 358,189 | | |

# Table A125.1.3 Annual Construction Cost of Water Supply System (2/2)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | **Flow Meter** | | | | | | | | | |
| | | | | | | | 50% | 50% | | |
| | DN 100 inch | N=3 nos. | - | 100% | 15,414 | | 7,707 | 7,707 | | |
| | | | F/C | 100% | 15,414 | | 7,707 | 7,707 | | |
| | | | L/C | 0% | 0 | | 0 | 0 | | |
| | | | | | | 50% | 50% | | | |
| | DN 72 inch | N=2 nos. | - | 100% | 6,482 | 3,241 | 3,241 | | | |
| | | | F/C | 100% | 6,482 | 3,241 | 3,241 | | | |
| | | | L/C | 0% | 0 | 0 | 0 | | | |
| | | | | | | | 50% | 50% | | |
| | DN 64 inch | N=1 no. | - | 100% | 2,806 | | 1,403 | 1,403 | | |
| | | | F/C | 100% | 2,806 | | 1,403 | 1,403 | | |
| | | | L/C | 0% | 0 | | 0 | 0 | | |
| | | | | | | | 50% | 50% | | |
| | DN 56 inch | N=1 no. | - | 100% | 2,451 | | 1,226 | 1,226 | | |
| | | | F/C | 100% | 2,451 | | 1,226 | 1,226 | | |
| | | | L/C | 0% | 0 | | 0 | 0 | | |
| | | | | | | | 50% | 50% | | |
| | DN 54 inch | N=2 nos. | - | 100% | 4,744 | | 2,372 | 2,372 | | |
| | | | F/C | 100% | 4,744 | | 2,372 | 2,372 | | |
| | | | L/C | 0% | 0 | | 0 | 0 | | |
| | | | | | | | 50% | 50% | | |
| | DN 48 inch | N=4 nos. | - | 100% | 8,696 | | 4,348 | 4,348 | | |
| | | | F/C | 100% | 8,696 | | 4,348 | 4,348 | | |
| | | | L/C | 0% | 0 | | 0 | 0 | | |
| | | | | | | | 50% | 50% | | |
| | DN 24 inch | N=2 nos. | - | 100% | 2,924 | | 1,462 | 1,462 | | |
| | | | F/C | 100% | 2,924 | | 1,462 | 1,462 | | |
| | | | L/C | 0% | 0 | | 0 | 0 | | |
| | | | | | | | 50% | 50% | | |
| | DN 18 inch | 2 nos. | - | 100% | 2,608 | | 1,304 | 1,304 | | |
| | | | F/C | 100% | 2,608 | | 1,304 | 1,304 | | |
| | | | L/C | 0% | 0 | | 0 | 0 | | |
| | | | | | | 7% | 50% | 43% | | |
| | Total (3) | N=17 nos. | - | 100% | 46,125 | 3,241 | 23,063 | 19,822 | | |
| | | | F/C | 100% | 46,125 | 3,241 | 23,063 | 19,822 | | |
| | | | L/C | 0% | 0 | 0 | 0 | 0 | | |
| 4 | **Distribution Network Main** | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | |
| | North Nazimabad Town | L=336,600 m | - | 100% | 1,009,800 | 252,450 | 504,900 | 252,450 | | |
| | | | F/C | 70% | 706,860 | 176,715 | 353,430 | 176,715 | | |
| | | | L/C | 30% | 302,940 | 75,735 | 151,470 | 75,735 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Gulberg Town | L=374,900 m | - | 100% | 1,124,700 | 281,176 | 562,350 | 281,174 | | |
| | | | F/C | 70% | 787,290 | 196,823 | 393,645 | 196,822 | | |
| | | | L/C | 30% | 337,410 | 84,353 | 168,705 | 84,352 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Liaquatabad Town | L=284,600 m | - | 100% | 853,800 | 213,450 | 426,900 | 213,450 | | |
| | | | F/C | 70% | 597,660 | 149,415 | 298,830 | 149,415 | | |
| | | | L/C | 30% | 256,140 | 64,035 | 128,070 | 64,035 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Total (4) | L=996,100 m | - | 100% | 2,988,300 | 747,076 | 1,494,150 | 747,074 | | |
| | | | F/C | 70% | 2,091,810 | 522,953 | 1,045,905 | 522,952 | | |
| | | | L/C | 30% | 896,490 | 224,123 | 448,245 | 224,122 | | |
| 5 | **House Connection** | | | | | | | | | |
| | **5.1 Water Meter Only** | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | |
| | North Nazimabad Town | N=8,800 nos. | - | 100% | 15,840 | 3,960 | 7,920 | 3,960 | | |
| | | | F/C | 100% | 15,840 | 3,960 | 7,920 | 3,960 | | |
| | | | L/C | 0% | 0 | 0 | 0 | 0 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Gulberg Town | N=9,200 nos. | - | 100% | 16,560 | 4,140 | 8,280 | 4,140 | | |
| | | | F/C | 100% | 16,560 | 4,140 | 8,280 | 4,140 | | |
| | | | L/C | 0% | 0 | 0 | 0 | 0 | | |
| | | | | | | 50% | 50% | | | |
| | Liaquatabad Town | N=2,100 nos. | - | 100% | 3,780 | 1,890 | 1,890 | 0 | | |
| | | | F/C | 100% | 3,780 | 1,890 | 1,890 | 0 | | |
| | | | L/C | 0% | 0 | 0 | 0 | 0 | | |
| | | | | | | 28% | 50% | 22% | | |
| | Total (5.1) | N=20,100 nos. | - | 100% | 36,180 | 9,990 | 18,090 | 8,100 | | |
| | | | F/C | 100% | 36,180 | 9,990 | 18,090 | 8,100 | | |
| | | | L/C | 0% | 0 | 0 | 0 | 0 | | |
| | **5.2 Water Meter and Service Pipe** | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | |
| | North Nazimabad Town | N=68,600 nos. | - | 100% | 329,280 | 82,320 | 164,641 | 82,319 | | |
| | | | F/C | 81% | 266,717 | 66,679 | 133,359 | 66,679 | | |
| | | | L/C | 19% | 62,563 | 15,641 | 31,282 | 15,640 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Gulberg Town | N=71,500 nos. | - | 100% | 343,200 | 85,800 | 171,600 | 85,800 | | |
| | | | F/C | 81% | 277,992 | 69,498 | 138,996 | 69,498 | | |
| | | | L/C | 19% | 65,208 | 16,302 | 32,604 | 16,302 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Liaquatabad Town | N=68,100 nos. | - | 100% | 326,880 | 81,720 | 163,441 | 81,719 | | |
| | | | F/C | 81% | 264,773 | 66,193 | 132,387 | 66,193 | | |
| | | | L/C | 19% | 62,107 | 15,527 | 31,054 | 15,526 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Total (5.2) | N=208,200 nos. | - | 100% | 999,360 | 249,840 | 499,682 | 249,838 | | |
| | | | F/C | 81% | 809,482 | 202,370 | 404,742 | 202,370 | | |
| | | | L/C | 19% | 189,878 | 47,470 | 94,940 | 47,468 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Total (5) | N=228,300 nos. | - | 100% | 1,035,540 | 259,830 | 517,772 | 257,938 | | |
| | | | F/C | 82% | 845,662 | 212,360 | 422,832 | 210,470 | | |
| | | | L/C | 18% | 189,878 | 47,470 | 94,940 | 47,468 | | |
| | | | | | | 24% | 50% | 26% | | |
| | Total (1-5) | | - | 100% | 9,166,805 | 2,241,886 | 4,583,406 | 2,341,514 | | |
| | | | F/C | 72% | 6,600,471 | 1,613,042 | 3,300,237 | 1,687,192 | | |
| | | | L/C | 28% | 2,566,334 | 628,844 | 1,283,169 | 654,322 | | |
| | | | | | | 40% | 40% | 20% | | |
| 6 | **Engineering Fee** | | - | 100% | 687,510 | 275,004 | 275,004 | 137,502 | | |
| | | F/C Total(1-5)x7.5% | F/C | 70% | 481,257 | 192,503 | 192,503 | 96,251 | | |
| | | L/C Total(1-5)x7.5% | L/C | 30% | 206,253 | 82,501 | 82,501 | 41,251 | | |
| 7 | **Land Acquisition** | | - | 100% | 3,680 | 3,680 | | | | |
| | | | F/C | 0% | 0 | 0 | | | | |
| | | | L/C | 100% | 3,680 | 3,680 | | | | |
| 8 | **Physical Contingency** | | - | 100% | 492,899 | 126,028 | 242,920 | 123,951 | | |
| | | F/C Total(1-7)x5.0% | F/C | 72% | 354,086 | 90,277 | 174,637 | 89,172 | | |
| | | L/C Total(1-7)x5.0% | L/C | 28% | 138,813 | 35,751 | 68,283 | 34,779 | | |
| 9 | **Price Contingency** | | - | 100% | 1,916,802 | 400,449 | 942,829 | 573,524 | | |
| | | F/C Total(1-8)x1.5% | F/C | 36% | 694,906 | 146,517 | 342,692 | 205,697 | | |
| | | L/C Total(1-8)x6.0% | L/C | 64% | 1,221,896 | 253,932 | 600,137 | 367,827 | | |
| 10 | **Project Administration** | | - | 100% | 184,015 | 45,706 | 90,662 | 47,647 | | |
| | | F/C Total(1-9)x1.5% | F/C | 0% | 0 | | | | | |
| | | L/C Total(1-9)x1.5% | L/C | 100% | 184,015 | 45,706 | 90,662 | 47,647 | | |
| | | | | | | 25% | 47% | 27% | | |
| | Total (6-10) | | - | 100% | 3,284,906 | 850,867 | 1,551,415 | 882,624 | | |
| | | | F/C | 47% | 1,530,249 | 429,297 | 709,832 | 391,120 | | |
| | | | L/C | 53% | 1,754,657 | 421,570 | 841,583 | 491,504 | | |
| | | | | | | 25% | 49% | 26% | | |
| | **Total (1-10)** | | - | 100% | 12,451,711 | 3,092,753 | 6,134,821 | 3,224,138 | | |
| | | | F/C | 65% | 8,130,720 | 2,042,339 | 4,010,069 | 2,078,312 | | |
| | | | L/C | 35% | 4,320,991 | 1,050,414 | 2,124,752 | 1,145,826 | | |

# Table A125.1.4 Annual Construction Cost of Sewerage System (1/4)

| No. | Components | Description | Curr-ency | Ratio | Amount Rs.thousand | Year 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **TP-1 Sewage Treatment Plant** | | | | | | | | | |
| | **1.1 Mechanical Equipment** | | | | | | | | | |
| | **a) Main Pumping Station** | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | |
| | Main Pump | 7 sets | - | 100% | 40,250 | 10,062 | 20,126 | 10,062 | | |
| | | Vertical1 Centrifugal, 31.2m$^3$/min 10.0m | F/C | 90% | 36,225 | 9,056 | 18,113 | 9,056 | | |
| | | 400V 3phase 90.0kw | L/C | 10% | 4,025 | 1,006 | 2013 | 1,006 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Electric Winch for Coarse Screen | 4 sets | - | 100% | 110 | 28 | 56 | 26 | | |
| | | Hoisting Load 1,000kg | F/C | 90% | 99 | 25 | 50 | 24 | | |
| | | 400V 3phase 1.5kw | L/C | 10% | 11 | 3 | 6 | 2 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Ventilation Fan | 2 sets | - | 100% | 253 | 63 | 127 | 63 | | |
| | | 400V 3phase 2.2kw | F/C | 90% | 228 | 57 | 114 | 57 | | |
| | | | L/C | 10% | 25 | 6 | 13 | 6 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Sump Pump | 2 sets | - | 100% | 253 | 63 | 127 | 63 | | |
| | | Submerged Pump | F/C | 90% | 228 | 57 | 114 | 57 | | |
| | | 400V 3phase 2.2kw | L/C | 10% | 25 | 6 | 13 | 6 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Total (a) | | - | 100% | 40,866 | 10,216 | 20,436 | 10,214 | | |
| | | | F/C | 90% | 36,780 | 9,195 | 18,391 | 9,194 | | |
| | | | L/C | 10% | 4,086 | 1,021 | 2,045 | 1,020 | | |
| | **b) Screen Chamber** | | | | | | | | | |
| | | | | | | 50% | 50% | | | |
| | Drive Equipment for Mechanical Rake | 4 sets | - | 100% | 110 | 56 | 54 | | | |
| | | 400V 3phase 1.5kw | F/C | 90% | 99 | 50 | 49 | | | |
| | | | L/C | 10% | 11 | 6 | 5 | | | |
| | **c) Detritor** | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | |
| | Drive Equipment for Grit Collector Rake | 2 sets | - | 100% | 92 | 23 | 47 | 22 | | |
| | | 400V 3phase 3.0kw | F/C | 90% | 83 | 21 | 42 | 20 | | |
| | | | L/C | 10% | 9 | 2 | 5 | 2 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Organics Return Pump | 2 sets | - | 100% | 41 | 10 | 21 | 10 | | |
| | | DN150 0.18L/s 1.0m | F/C | 90% | 37 | 9 | 19 | 9 | | |
| | | 400V 3phase 0.2kw | L/C | 10% | 4 | 1 | 2 | 1 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Drive Equipment for Grit Removal Rake | 2 sets | - | 100% | 55 | 14 | 28 | 13 | | |
| | | 400V 3phase 1.5kw | F/C | 90% | 50 | 13 | 25 | 12 | | |
| | | | L/C | 10% | 5 | 1 | 3 | 1 | | |
| | | | | | | 25% | 51% | 24% | | |
| | Total (c) | | - | 100% | 188 | 47 | 96 | 45 | | |
| | | | F/C | 90% | 170 | 43 | 86 | 41 | | |
| | | | L/C | 10% | 18 | 4 | 10 | 4 | | |
| | **d) Primary Settling Tank** | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | |
| | Equipment of Sludge Collector Rake | 4 sets | - | 100% | 25,300 | 6,326 | 12,650 | 6,324 | | |
| | | Diameter 42.0m, Steel Product | F/C | 90% | 22,770 | 5,693 | 11,385 | 5,692 | | |
| | | | L/C | 10% | 2,530 | 633 | 1265 | 632 | | |
| | **e) Trickling Filter** | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | |
| | Water Spray Bar | 8 sets | - | 100% | 50,600 | 12,650 | 25,300 | 12,650 | | |
| | | Diameter 41.4m, Steel Product | F/C | 90% | 45,540 | 11,385 | 22,770 | 11,385 | | |
| | | | L/C | 10% | 5,060 | 1,265 | 2530 | 1,265 | | |
| | **f) Final Settling Tank** | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | |
| | Equipment of Sludge Collector Rake | 4 sets | - | 100% | 25,300 | 6,326 | 12,650 | 6,324 | | |
| | | Diameter 42.0m, Steel Product | F/C | 90% | 22,770 | 5,693 | 11,385 | 5,692 | | |
| | | | L/C | 10% | 2,530 | 633 | 1265 | 632 | | |
| | **g) Sludge Pump Station No.1** | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | |
| | Humus Sludge Pump | 2 sets | - | 100% | 5,060 | 1,266 | 2,530 | 1,264 | | |
| | | Vertical Centrifugal, 2.4m$^3$/s 12.3m | F/C | 90% | 4,554 | 1,139 | 2,277 | 1,138 | | |
| | | 400V 3phase 11.0kw | L/C | 10% | 506 | 127 | 253 | 126 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Lagoon Feed Pump | 3 sets | - | 100% | 9,660 | 2,416 | 4,830 | 2,414 | | |
| | | Vertical Centrifugal, 2.0m$^3$/min 20.0m | F/C | 90% | 8,694 | 2,174 | 4,347 | 2,173 | | |
| | | 400V 3phase 15.0kw | L/C | 10% | 966 | 242 | 483 | 241 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Ventilation Fan | 1 set | - | 100% | 127 | 32 | 64 | 31 | | |
| | | 400V 3phase 2.2kw | F/C | 90% | 114 | 29 | 57 | 28 | | |
| | | | L/C | 10% | 13 | 3 | 7 | 3 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Sump Pump | 2 sets | - | 100% | 253 | 63 | 127 | 63 | | |
| | | Submerged Pump | F/C | 90% | 228 | 57 | 114 | 57 | | |
| | | 400V 3phase 1.5kw | L/C | 10% | 25 | 6 | 13 | 6 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Total (g) | | - | 100% | 15,100 | 3,777 | 7,551 | 3,772 | | |
| | | | F/C | 90% | 13,590 | 3,399 | 6,795 | 3,396 | | |
| | | | L/C | 10% | 1,510 | 378 | 756 | 376 | | |
| | **h) Sludge Pump Station No.2** | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | |
| | Humus Sludge Pump | 2 sets | - | 100% | 5,060 | 1,266 | 2,530 | 1,264 | | |
| | | Vertical Centrifugal, 2.4m$^3$/s 12.3m | F/C | 90% | 4,554 | 1,139 | 2,277 | 1,138 | | |
| | | 400V 3phase 11.0kw | L/C | 10% | 506 | 127 | 253 | 126 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Pressure Pump | 1 set | - | 100% | 2,530 | 632 | 1,266 | 632 | | |
| | | Horizontal Centrifugal with Pressure Tank | F/C | 90% | 2,277 | 569 | 1,139 | 569 | | |
| | | 400V 3phase 2.5kw | L/C | 10% | 253 | 63 | 127 | 63 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Ventilation Fan | 1 set | - | 100% | 127 | 32 | 64 | 31 | | |
| | | 400V 3phase 2.2kw | F/C | 90% | 114 | 29 | 57 | 28 | | |
| | | | L/C | 10% | 13 | 3 | 7 | 3 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Sump Pump | 2 sets | - | 100% | 253 | 63 | 127 | 63 | | |
| | | Submerged Pump | F/C | 90% | 228 | 57 | 114 | 57 | | |
| | | 400V 3phase 1.5kw | L/C | 10% | 25 | 6 | 13 | 6 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Total (h) | | - | 100% | 7,970 | 1,993 | 3,987 | 1,990 | | |
| | | | F/C | 90% | 7,173 | 1,794 | 3,587 | 1,792 | | |
| | | | L/C | 10% | 797 | 199 | 400 | 198 | | |
| | | | | | | 25% | 50% | 25% | | |
| | Total (1.1) | | - | 100% | 165,434 | 41,391 | 82,724 | 41,319 | | |
| | | | F/C | 90% | 148,892 | 37,252 | 74,448 | 37,192 | | |
| | | | L/C | 10% | 16,542 | 4,139 | 8,276 | 4,127 | | |

# Table A125.1.4 Annual Construction Cost of Sewerage System (2/4)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **1.2 Electrical Equipment** | | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | |
| **a) Incoming Panel** | 2 sets | - | 100% | 3,910 | 978 | 1,956 | 976 | | | |
| | Indoor Installation | F/C | 90% | 3,519 | 880 | 1,760 | 879 | | | |
| | | L/C | 10% | 391 | 98 | 196 | 97 | | | |
| | | | | | 25% | 50% | 25% | | | |
| **b) Electrical Transformer** | 1 set | - | 100% | 6,325 | 1,581 | 3,163 | 1,581 | | | |
| | 1,000kVA Indoor Installation | F/C | 90% | 5,693 | 1,423 | 2,847 | 1,423 | | | |
| | | L/C | 10% | 632 | 158 | 316 | 158 | | | |
| | | | | | 25% | 50% | 25% | | | |
| **c) Main Low Voltage Panel** | 1 set | - | 100% | 2,070 | 518 | 1,036 | 516 | | | |
| | Indoor Installation | F/C | 90% | 1,863 | 466 | 932 | 465 | | | |
| | | L/C | 10% | 207 | 52 | 104 | 51 | | | |
| | | | | | 25% | 50% | 25% | | | |
| **d) PF Improvement Panel** | 2 sets | - | 100% | 1,150 | 288 | 576 | 286 | | | |
| | SC 100kVarx1 | F/C | 90% | 1,035 | 259 | 518 | 258 | | | |
| | Indoor Installation | L/C | 10% | 115 | 29 | 58 | 28 | | | |
| | | | | | 25% | 50% | 25% | | | |
| **e) PF Improvement Panel** | 1 set | - | 100% | 690 | 172 | 346 | 172 | | | |
| | SC 125kVarx1 | F/C | 90% | 621 | 155 | 311 | 155 | | | |
| | Indoor Installation | L/C | 10% | 69 | 17 | 35 | 17 | | | |
| | | | | | 25% | 50% | 25% | | | |
| **f) Motor Control Center** | 1 set | - | 100% | 2,645 | 661 | 1,323 | 661 | | | |
| | PS-1 | F/C | 90% | 2,381 | 595 | 1,191 | 595 | | | |
| | Indoor Installation | L/C | 10% | 264 | 66 | 132 | 66 | | | |
| | | | | | 25% | 50% | 25% | | | |
| **g) Motor Control Center** | 1 set | - | 100% | 230 | 58 | 116 | 56 | | | |
| | Inlet Works -1 | F/C | 90% | 207 | 52 | 104 | 51 | | | |
| | Outdoor Installation | L/C | 10% | 23 | 6 | 12 | 5 | | | |
| | | | | | 25% | 50% | 25% | | | |
| **h) Motor Control Center** | 1 set | - | 100% | 230 | 58 | 116 | 56 | | | |
| | Inlet Works -2 | F/C | 90% | 207 | 52 | 104 | 51 | | | |
| | Outdoor Installation | L/C | 10% | 23 | 6 | 12 | 5 | | | |
| | | | | | 25% | 50% | 25% | | | |
| **i) Motor Control Center** | 1 set | - | 100% | 690 | 172 | 346 | 172 | | | |
| | SPS-1 | F/C | 90% | 621 | 155 | 311 | 155 | | | |
| | Indoor Installation | L/C | 10% | 69 | 17 | 35 | 17 | | | |
| | | | | | 25% | 50% | 25% | | | |
| **j) Motor Control Center** | 1 set | - | 100% | 345 | 87 | 173 | 85 | | | |
| | SPS-2 | F/C | 90% | 311 | 78 | 156 | 77 | | | |
| | Indoor Installation | L/C | 10% | 34 | 9 | 17 | 8 | | | |
| | | | | | 25% | 50% | 25% | | | |
| **k) Local Control Switch** | 55 sets | - | 100% | 380 | 96 | 190 | 94 | | | |
| | Indoor Installation | F/C | 90% | 342 | 86 | 171 | 85 | | | |
| | | L/C | 10% | 38 | 10 | 19 | 9 | | | |
| | | | | | 25% | 50% | 25% | | | |
| **l) Generator Set** | 1 set | - | 100% | 16,905 | 4,227 | 8,453 | 4,225 | | | |
| | Diesel Type 750kVA 4,500 litter Fuel Tank | F/C | 90% | 15,215 | 3,804 | 7,608 | 3,803 | | | |
| | Indoor Installation | L/C | 10% | 1,690 | 423 | 845 | 422 | | | |
| | | | | | 25% | 50% | 25% | | | |
| **m) Level Meter** | 7 sets | - | 100% | 4,830 | 1,208 | 2,416 | 1,206 | | | |
| | Ultrasonic Type 0 to 5m | F/C | 90% | 4,347 | 1,087 | 2,174 | 1,086 | | | |
| | Outdoor Installation | L/C | 10% | 483 | 121 | 242 | 120 | | | |
| | | | | | 25% | 50% | 25% | | | |
| **n) Flow Meter** | 2 sets | - | 100% | 1,610 | 402 | 806 | 402 | | | |
| | Ultrasonic Open Channel Type | F/C | 90% | 1,449 | 362 | 725 | 362 | | | |
| | 0 to 3,500m$^3$/h Outdoor Installation | L/C | 10% | 161 | 40 | 81 | 40 | | | |
| | | | | | 25% | 50% | 25% | | | |
| Total (1.2) | | - | 100% | 42,010 | 10,506 | 21,016 | 10,488 | | | |
| | | F/C | 90% | 37,811 | 9,454 | 18,912 | 9,445 | | | |
| | | L/C | 10% | 4,199 | 1,052 | 2,104 | 1,043 | | | |
| **1.3 Removal and Installation** | | | | | | | | | | |
| | | | | | 25% | 50% | 25% | | | |
| Mechanical and Electrical Equipment | | - | 100% | 81,174 | 20,294 | 40,588 | 20,292 | | | |
| | | F/C | 20% | 16,235 | 4,059 | 8,118 | 4,058 | | | |
| | | L/C | 80% | 64,939 | 16,235 | 32470 | 16,234 | | | |
| **1.4 Internal pipe of Sewage Treatment Plant** | | | | | | | | | | |
| | | | | | 25% | 50% | 25% | | | |
| Chamber of JP5 and JP6 | DN1,050 L=70m | - | 100% | 1,804 | 451 | 903 | 450 | | | |
| to Final Settling Tank | | F/C | 70% | 1,263 | 316 | 632 | 315 | | | |
| | | L/C | 30% | 541 | 135 | 271 | 135 | | | |
| | | | | | 25% | 50% | 25% | | | |
| Sludge, Scum and Drain Pipe Line | DN100 - DN300 L=4,800m | - | 100% | 46,857 | 11,714 | 23,429 | 11,714 | | | |
| | | F/C | 70% | 32,800 | 8,200 | 16,400 | 8,200 | | | |
| | | L/C | 30% | 14,057 | 3,514 | 7029 | 3,514 | | | |
| | | | | | 25% | 50% | 25% | | | |
| Total (1.4) | | - | 100% | 48,661 | 12,165 | 24,332 | 12,164 | | | |
| | | F/C | 70% | 34,063 | 8,516 | 17,032 | 8,515 | | | |
| | | L/C | 30% | 14,598 | 3,649 | 7,300 | 3,649 | | | |
| | | | | | 25% | 50% | 25% | | | |
| Total (1) | | - | 100% | 337,279 | 84,356 | 168,660 | 84,263 | | | |
| | | F/C | 70% | 237,001 | 59,281 | 118,510 | 59,210 | | | |
| | | L/C | 30% | 100,278 | 25,075 | 50,150 | 25,053 | | | |
| **2 TP-3 Sewage Treatment Plant** | | | | | | | | | | |
| **2.1 Mechanical Equipment** | | | | | | | | | | |
| **a) Main Pumping Station** | | | | | | | | | | |
| | | | | | 50% | 50% | | | | |
| Motor for Bar Screen | 4 sets | - | 100% | 110 | 56 | 54 | | | | |
| | 400V 3phase 1.5kW | F/C | 90% | 99 | 50 | 49 | | | | |
| | | L/C | 10% | 11 | 6 | 5 | | | | |
| | | | | | 50% | 50% | | | | |
| Potable Water Pump | 3 sets | - | 100% | 3,795 | 1898 | 1897 | | | | |
| | Centrifugal Pump | F/C | 90% | 3,416 | 1708 | 1,708 | | | | |
| | | L/C | 10% | 379 | 190 | 189 | | | | |
| | | | | | 50% | 50% | 0% | | | |
| Total (a) | | - | 100% | 3,905 | 1,954 | 1,951 | 0 | | | |
| | | F/C | 90% | 3,515 | 1,758 | 1,757 | 0 | | | |
| | | L/C | 10% | 390 | 196 | 194 | 0 | | | |
| **b) Screen Chamber** | | | | | | | | | | |
| | | | | | 50% | 50% | | | | |
| Drive Equipment for Mechanical Rake | 5sets | - | 100% | 138 | 69 | 69 | | | | |
| | 400V 3phase 1.50kW | F/C | 90% | 124 | 62 | 62 | | | | |
| | | L/C | 10% | 14 | 7 | 7 | | | | |
| **c) Detritor** | | | | | | | | | | |
| | | | | | 50% | 50% | | | | |
| Drive Equipment for Grit Collector Rake | 3sets | - | 100% | 138 | 69 | 69 | | | | |
| | 400V 3phase 3.00kW | F/C | 90% | 124 | 62 | 62 | | | | |
| | | L/C | 10% | 14 | 7 | 7 | | | | |
| | | | | | 50% | 50% | | | | |
| Organics Return Pump | 3sets | - | 100% | 62 | 31 | 31 | | | | |
| | 400V 3phase 0.20kW | F/C | 90% | 56 | 28 | 28 | | | | |
| | | L/C | 10% | 6 | 3 | 3 | | | | |
| | | | | | 50% | 50% | | | | |
| Drive Equipment for Grit Removal Rake | 3sets | - | 100% | 83 | 42 | 41 | | | | |
| | 400V 3phase 1.50kW | F/C | 90% | 75 | 38 | 37 | | | | |
| | | L/C | 10% | 8 | 4 | 4 | | | | |
| | | | | | 50% | 50% | | | | |
| Potable Water Pump | 2 sets | - | 100% | 2,530 | 1,266 | 1,264 | | | | |
| | Centrifugal Pump | F/C | 90% | 2,277 | 1,139 | 1,138 | | | | |
| | | L/C | 10% | 253 | 127 | 126 | | | | |
| | | | | | 50% | 50% | | | | |
| Drainage Pump | 2 sets | - | 100% | 253 | 127 | 126 | | | | |
| | Submersible Sewage Pump | F/C | 90% | 228 | 114 | 114 | | | | |
| | | L/C | 10% | 25 | 13 | 12 | | | | |
| | | | | | 50% | 50% | 0% | | | |
| Total (c) | | - | 100% | 3,066 | 1,535 | 1,531 | 0 | | | |
| | | F/C | 90% | 2,760 | 1,381 | 1,379 | 0 | | | |
| | | L/C | 10% | 306 | 154 | 152 | 0 | | | |

# Table A125.1.4 Annual Construction Cost of Sewerage System (3/4)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **d) Anaerobic Pond** | | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | Secondary Pump | 18 sets | - | 100% | 91,080 | 22,770 | 45,540 | 22,770 | | | |
| | | Vertical Sewage Pump 50m$^3$/min x 7mH | F/C | 90% | 81,972 | 20,493 | 40,986 | 20,493 | | | |
| | | 400V 3phase 75.00kW | L/C | 10% | 9,108 | 2,277 | 4554 | 2,277 | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | Ventilation Fan | 6 sets | - | 100% | 759 | 190 | 380 | 189 | | | |
| | | 400V 3phase 2.20kW | F/C | 90% | 683 | 171 | 342 | 170 | | | |
| | | | L/C | 10% | 76 | 19 | 38 | 19 | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | Sump Pump | 12 sets | - | 100% | 1,518 | 380 | 759 | 379 | | | |
| | | 400V 3phase 1.50kW | F/C | 90% | 1,366 | 342 | 683 | 341 | | | |
| | | | L/C | 10% | 152 | 38 | 76 | 38 | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | Total (d) | | - | 100% | 93,357 | 23,340 | 46,679 | 23,338 | | | |
| | | | F/C | 90% | 84,021 | 21,006 | 42,011 | 21,004 | | | |
| | | | L/C | 10% | 9,336 | 2,334 | 4,668 | 2,334 | | | |
| | | | | | | 27% | 50% | 23% | | | |
| | Total (2.1) | | - | 100% | 100,466 | 26,898 | 50,230 | 23,338 | | | |
| | | | F/C | 90% | 90,420 | 24,207 | 45,209 | 21,004 | | | |
| | | | L/C | 10% | 10,046 | 2,691 | 5,021 | 2,334 | | | |
| | **2.2 Electrical Equipment** | | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | **a) Motor Control Center** | 1 set | - | 100% | 460 | 116 | 230 | 114 | | | |
| | | Inlet Works | F/C | 90% | 414 | 104 | 207 | 103 | | | |
| | | Indoor Installation | L/C | 10% | 46 | 12 | 23 | 11 | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | **b) Motor Control Center** | 6 sets | - | 100% | 13,800 | 3,450 | 6,900 | 3,450 | | | |
| | | SPS | F/C | 90% | 12,420 | 3,105 | 6,210 | 3,105 | | | |
| | | Indoor Installation | L/C | 10% | 1,380 | 345 | 690 | 345 | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | **c) Local Control Switch** | 61 sets | - | 100% | 421 | 106 | 211 | 104 | | | |
| | | | F/C | 90% | 379 | 95 | 190 | 94 | | | |
| | | | L/C | 10% | 42 | 11 | 21 | 10 | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | **d) Level Meter** | 6 sets | - | 100% | 4,140 | 1,036 | 2,070 | 1,034 | | | |
| | | Ultrasonic Type 0 to 5m | F/C | 90% | 3,726 | 932 | 1,863 | 931 | | | |
| | | Outdoor Installation | L/C | 10% | 414 | 104 | 207 | 103 | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | **e) Flow Meter** | 6 sets | - | 100% | 4,830 | 1,208 | 2,416 | 1,206 | | | |
| | | Ultrasonic Open Channel Type | F/C | 90% | 4,347 | 1,087 | 2,174 | 1,086 | | | |
| | | Outdoor Installation | L/C | 10% | 483 | 121 | 242 | 120 | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | Total (2.2) | | - | 100% | 23,651 | 5,916 | 11,827 | 5,908 | | | |
| | | | F/C | 90% | 21,286 | 5,323 | 10,644 | 5,319 | | | |
| | | | L/C | 10% | 2,365 | 593 | 1,183 | 589 | | | |
| | **2.3 Removal and Installation** | | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | Mechanical and Electrical Equipment | | - | 100% | 48,568 | 12,143 | 24,284 | 12,141 | | | |
| | | | F/C | 20% | 9,714 | 2,429 | 4,857 | 2,428 | | | |
| | | | L/C | 80% | 38,854 | 9,714 | 19427 | 9,713 | | | |
| | **2.4Pump House for Secondary Pump** | | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | Pump House | 6 Houses | - | 100% | 26,000 | 6,500 | 13,000 | 6,500 | | | |
| | | W=10.0m L=15.0m H=5.0m | F/C | 25% | 6,500 | 1,625 | 3,250 | 1,625 | | | |
| | | | L/C | 75% | 19,500 | 4,875 | 9750 | 4,875 | | | |
| | | | | | | 26% | 50% | 24% | | | |
| | Total (2) | | - | 100% | 198,685 | 51,457 | 99,341 | 47,887 | | | |
| | | | F/C | 64% | 127,920 | 33,584 | 63,960 | 30,376 | | | |
| | | | L/C | 36% | 70,765 | 17,873 | 35,381 | 17,511 | | | |
| 3 | **Sewer and Box Culvert** | | | | | | | | | | |
| | **a) Branch Sewer** | | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | North Nazimabad Town | DN10 inch L=100,100m | - | 100% | 350,350 | 87,588 | 175,175 | 87,587 | | | |
| | | | F/C | 20% | 70,070 | 17,518 | 35,035 | 17,517 | | | |
| | | | L/C | 80% | 280,280 | 70,070 | 140,140 | 70,070 | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | Gulberg Town | DN10 inch L=86,700m | - | 100% | 303,450 | 75,863 | 151,725 | 75,862 | | | |
| | | | F/C | 20% | 60,690 | 15,173 | 30,345 | 15,172 | | | |
| | | | L/C | 80% | 242,760 | 60,690 | 121,380 | 60,690 | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | Liaquatabad Town | DN10 inch L=82,500m | - | 100% | 288,750 | 72,188 | 144,375 | 72,187 | | | |
| | | | F/C | 20% | 57,750 | 14,438 | 28,875 | 14,437 | | | |
| | | | L/C | 80% | 231,000 | 57,750 | 115,500 | 57,750 | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | Total (a) | L=269,300m | - | 100% | 942,550 | 235,639 | 471,275 | 235,636 | | | |
| | | | F/C | 20% | 188,510 | 47,129 | 94,255 | 47,126 | | | |
| | | | L/C | 80% | 754,040 | 188,510 | 377,020 | 188,510 | | | |
| | **b) Trunk Sewer** | | | | | | | | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | North Nazimabad Town | DN12 inch L=3,680m | - | 100% | 33,120 | 8,280 | 16,560 | 8,280 | | | |
| | | | F/C | 20% | 6,624 | 1,656 | 3,312 | 1,656 | | | |
| | | | L/C | 80% | 26,496 | 6,624 | 13,248 | 6,624 | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | | DN15 inch L=4,570m | - | 100% | 48,442 | 12,111 | 24,221 | 12,110 | | | |
| | | | F/C | 20% | 9,688 | 2,422 | 4,844 | 2,422 | | | |
| | | | L/C | 80% | 38,754 | 9,689 | 19,377 | 9,688 | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | | DN18 inch L=2,790m | - | 100% | 35,433 | 8,859 | 17,717 | 8,857 | | | |
| | | | F/C | 20% | 7,087 | 1,772 | 3,544 | 1,771 | | | |
| | | | L/C | 80% | 28,346 | 7,087 | 14,173 | 7,086 | | | |
| | | | | | | | 50% | 50% | | | |
| | | DN27 inch L=820m | - | 100% | 14,186 | | 7,094 | 7,092 | | | |
| | | | F/C | 20% | 2,837 | | 1,419 | 1,418 | | | |
| | | | L/C | 80% | 11,349 | | 5,675 | 5,674 | | | |
| | | | | | | 50% | 50% | | | | |
| | | DN30 inch L=1,630m | - | 100% | 29,829 | 14,915 | 14,914 | | | | |
| | | | F/C | 20% | 5,966 | 2,983 | 2,983 | | | | |
| | | | L/C | 80% | 23,863 | 11,932 | 11,931 | | | | |
| | | | | | | 50% | 50% | | | | |
| | | DN33 inch L=970m | - | 100% | 17,945 | 8,973 | 8,972 | | | | |
| | | | F/C | 20% | 3,589 | 1,795 | 1,794 | | | | |
| | | | L/C | 80% | 14,356 | 7,178 | 7,178 | | | | |
| | | | | | | 50% | 50% | | | | |
| | | DN36 inch L=1,080m | - | 100% | 21,168 | 10,584 | 10,584 | | | | |
| | | | F/C | 20% | 4,234 | 2,117 | 2,117 | | | | |
| | | | L/C | 80% | 16,934 | 8,467 | 8,467 | | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | | DN42 inch L=2,460m | - | 100% | 88,068 | 22,018 | 44,034 | 22,016 | | | |
| | | | F/C | 20% | 17,614 | 4,404 | 8,807 | 4,403 | | | |
| | | | L/C | 80% | 70,454 | 17,614 | 35,227 | 17,613 | | | |
| | | | | | | 50% | 50% | | | | |
| | | DN48 inch L=1,630m | - | 100% | 69,275 | 34,638 | 34,637 | | | | |
| | | | F/C | 20% | 13,855 | 6,928 | 6,927 | | | | |
| | | | L/C | 80% | 55,420 | 27,710 | 27,710 | | | | |
| | | | | | | 50% | 50% | | | | |
| | | DN54 inch L=990m | - | 100% | 43,560 | 21,780 | 21,780 | | | | |
| | | | F/C | 20% | 8,712 | 4,356 | 4,356 | | | | |
| | | | L/C | 80% | 34,848 | 17,424 | 17,424 | | | | |
| | | | | | | 35% | 50% | 15% | | | |
| | Total | L=20,620m | - | 100% | 401,026 | 142,158 | 200,513 | 58,355 | | | |
| | | | F/C | 20% | 80,206 | 28,433 | 40,103 | 11,670 | | | |
| | | | L/C | 80% | 320,820 | 113,725 | 160,410 | 46,685 | | | |

# Table A125.1.4 Annual Construction Cost of Sewerage System (4/4)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 50% | 50% | | |
| | Gulberg Town | DN12 inch L=1,540m | - | 100% | 13,860 | | 6,930 | 6,930 | | | |
| | | | F/C | 20% | 2,772 | | 1,386 | 1,386 | | | |
| | | | L/C | 80% | 11,088 | | 5,544 | 5,544 | | | |
| | | | | | | | 50% | 50% | | | |
| | | DN15 inch L=1,650m | - | 100% | 17,490 | | 8,745 | 8,745 | | | |
| | | | F/C | 20% | 3,498 | | 1,749 | 1,749 | | | |
| | | | L/C | 80% | 13,992 | | 6,996 | 6,996 | | | |
| | | | | | | | 50% | 50% | | | |
| | | DN18 inch L=1,350m | - | 100% | 17,145 | | 8,573 | 8,572 | | | |
| | | | F/C | 20% | 3,429 | | 1,715 | 1,714 | | | |
| | | | L/C | 80% | 13,716 | | 6,858 | 6,858 | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | | DN24 inch L=4,410m | - | 100% | 72,765 | 18,191 | 36,383 | 18,191 | | | |
| | | | F/C | 20% | 14,553 | 3,638 | 7,277 | 3,638 | | | |
| | | | L/C | 80% | 58,212 | 14,553 | 29,106 | 14,553 | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | | DN27 inch L=2,290m | - | 100% | 39,617 | 9,905 | 19,809 | 9,903 | | | |
| | | | F/C | 20% | 7,923 | 1,981 | 3,962 | 1,980 | | | |
| | | | L/C | 80% | 31,694 | 7,924 | 15,847 | 7,923 | | | |
| | | | | | | 50% | 50% | | | | |
| | | DN30 inch L=1,600m | - | 100% | 29,280 | 14,640 | 14,640 | | | | |
| | | | F/C | 20% | 5,856 | 2,928 | 2,928 | | | | |
| | | | L/C | 80% | 23,424 | 11,712 | 11,712 | | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | | DN33 inch L=3,090m | - | 100% | 57,165 | 14,291 | 28,583 | 14,291 | | | |
| | | | F/C | 20% | 11,433 | 2,858 | 5,717 | 2,858 | | | |
| | | | L/C | 80% | 45,732 | 11,433 | 22,866 | 11,433 | | | |
| | | | | | | 23% | 50% | 27% | | | |
| | Total | L=15,930m | - | 100% | 247,322 | 57,027 | 123,663 | 66,632 | | | |
| | | | F/C | 20% | 49,464 | 11,405 | 24,734 | 13,325 | | | |
| | | | L/C | 80% | 197,858 | 45,622 | 98,929 | 53,307 | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | North Nazimabad Town | DN12 inch L=4,410m | - | 100% | 39,690 | 9,923 | 19,845 | 9,922 | | | |
| | | | F/C | 20% | 7,938 | 1,985 | 3,969 | 1,984 | | | |
| | | | L/C | 80% | 31,752 | 7,938 | 15,876 | 7,938 | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | | DN15 inch L=2,000m | - | 100% | 21,200 | 5,300 | 10,600 | 5,300 | | | |
| | | | F/C | 20% | 4,240 | 1,060 | 2,120 | 1,060 | | | |
| | | | L/C | 80% | 16,960 | 4,240 | 8,480 | 4,240 | | | |
| | | | | | | | 50% | 50% | | | |
| | | DN18 inch L=1,390m | - | 100% | 17,653 | | 8,827 | 8,826 | | | |
| | | | F/C | 20% | 3,531 | | 1,766 | 1,765 | | | |
| | | | L/C | 80% | 14,122 | | 7,061 | 7,061 | | | |
| | | | | | | | 50% | 50% | | | |
| | | DN24 inch L=1,200m | - | 100% | 19,800 | | 9,900 | 9,900 | | | |
| | | | F/C | 20% | 3,960 | | 1,980 | 1,980 | | | |
| | | | L/C | 80% | 15,840 | | 7,920 | 7,920 | | | |
| | | | | | | | 50% | 50% | | | |
| | | DN27 inch L=1,760m | - | 100% | 30,448 | | 15,224 | 15,224 | | | |
| | | | F/C | 20% | 6,090 | | 3,045 | 3,045 | | | |
| | | | L/C | 80% | 24,358 | | 12,179 | 12,179 | | | |
| | | | | | | 50% | 50% | | | | |
| | | DN36 inch L=1,130m | - | 100% | 22,148 | 11,074 | 11,074 | | | | |
| | | | F/C | 20% | 4,430 | 2,215 | 2,215 | | | | |
| | | | L/C | 80% | 17,718 | 8,859 | 8,859 | | | | |
| | | | | | | 50% | 50% | | | | |
| | | DN48 inch L=1,610m | - | 100% | 68,425 | 34,213 | 34,212 | | | | |
| | | | F/C | 20% | 13,685 | 6,843 | 6,842 | | | | |
| | | | L/C | 80% | 54,740 | 27,370 | 27,370 | | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | | DN54 inch L=2,040m | - | 100% | 89,760 | 22,440 | 44,880 | 22,440 | | | |
| | | | F/C | 20% | 17,952 | 4,488 | 8,976 | 4,488 | | | |
| | | | L/C | 80% | 71,808 | 17,952 | 35,904 | 17,952 | | | |
| | | | | | | 50% | 50% | | | | |
| | | DN84 inch L=890m | - | 100% | 81,702 | 40,851 | 40,851 | | | | |
| | | | F/C | 20% | 16,340 | 8,170 | 8,170 | | | | |
| | | | L/C | 80% | 65,362 | 32,681 | 32,681 | | | | |
| | | | | | | 25% | 50% | 25% | | | |
| | | 1,750×1,750 Box Culvert L=1,010m Double Culvert | - | 100% | 131,906 | 32,976 | 65,954 | 32,976 | | | |
| | | | F/C | 20% | 26,381 | 6,595 | 13,191 | 6,595 | | | |
| | | | L/C | 80% | 105,525 | 26,381 | 52,763 | 26,381 | | | |
| | | | | | | 30% | 50% | 20% | | | |
| | Total | L=17,440m | - | 100% | 522,732 | 156,777 | 261,367 | 104,588 | | | |
| | | | F/C | 20% | 104,547 | 31,356 | 52,274 | 20,917 | | | |
| | | | L/C | 80% | 418,185 | 125,421 | 209,093 | 83,671 | | | |
| | | | | | | 30% | 50% | 20% | | | |
| | Total (b) | L=53,990m | - | 100% | 1,171,080 | 355,962 | 585,543 | 229,575 | | | |
| | | | F/C | 20% | 234,217 | 71,194 | 117,111 | 45,912 | | | |
| | | | L/C | 80% | 936,863 | 284,768 | 468,432 | 183,663 | | | |
| | | | | | | 28% | 50% | 22% | | | |
| | Total (3) | | - | 100% | 2,113,630 | 591,601 | 1,056,818 | 465,211 | | | |
| | | | F/C | 20% | 422,727 | 118,323 | 211,366 | 93,038 | | | |
| | | | L/C | 80% | 1,690,903 | 473,278 | 845,452 | 372,173 | | | |
| | | | | | | 27% | 50% | 23% | | | |
| | Total (1-3) | | - | 100% | 2,649,594 | 727,414 | 1,324,819 | 597,361 | | | |
| | | | F/C | 30% | 787,648 | 211,188 | 393,836 | 182,624 | | | |
| | | | L/C | 70% | 1,861,946 | 516,226 | 930,983 | 414,737 | | | |
| | | | | | | 40% | 40% | 20% | | | |
| **4** | **Engineering Fee** | | - | 100% | 198,720 | 79,488 | 79,488 | 39,744 | | | |
| | | F/C Total(1-3)×7.5% | F/C | 70% | 139,104 | 55,642 | 55,642 | 27,820 | | | |
| | | L/C Total(1-3)×7.5% | L/C | 30% | 59,616 | 23,846 | 23,846 | 11,924 | | | |
| **5** | **Physical Contingency** | | - | 100% | 142,416 | 40,346 | 70,215 | 31,855 | | | |
| | | F/C Total(1-4)×5.0% | F/C | 33% | 46,338 | 13,342 | 22,474 | 10,522 | | | |
| | | L/C Total(1-4)×5.0% | L/C | 67% | 96,078 | 27,004 | 47,741 | 21,333 | | | |
| **6** | **Price Contingency** | | - | 100% | 927,044 | 213,453 | 463,696 | 249,895 | | | |
| | | F/C Total(1-5)×1.5% | F/C | 10% | 90,026 | 21,653 | 44,101 | 24,272 | | | |
| | | L/C Total(1-5)×6.0% | L/C | 90% | 837,018 | 191,800 | 419,595 | 225,623 | | | |
| **7** | **Project Administration** | | - | 100% | 58,767 | 15,911 | 29,073 | 13,783 | | | |
| | | F/C Total(1-6)×1.5% | F/C | 0% | 0 | | | | | | |
| | | L/C Total(1-6)×1.5% | L/C | 100% | 58,767 | 15,911 | 29,073 | 13,783 | | | |
| | | | | | | 26% | 48% | 25% | | | |
| | Total (4-7) | | - | 100% | 1,326,947 | 349,198 | 642,472 | 335,277 | | | |
| | | | F/C | 21% | 275,468 | 90,637 | 122,217 | 62,614 | | | |
| | | | L/C | 79% | 1,051,479 | 258,561 | 520,255 | 272,663 | | | |
| | | | | | | 27% | 49% | 23% | | | |
| | **Total (1-7)** | | - | 100% | 3,976,541 | 1,076,612 | 1,967,291 | 932,638 | | | |
| | | | F/C | 27% | 1,063,116 | 301,825 | 516,053 | 245,238 | | | |
| | | | L/C | 73% | 2,913,425 | 774,787 | 1,451,238 | 687,400 | | | |

## Table A125.1.5 Operation and Maintenance Cost of Water Supply System

(Unit : Rs. Thousand/year)

| Item | Description | | Year 2016 |
|---|---|---|---|
| Purchased Water Fee | 84MGD from Zone Central | | 643,860 |
| Trunk Distribution Main | | Operation Cost | 0 |
| | Rehabilitation, DN14-DN64inch L=49,490m | Maintenance Cost | 92,120 |
| | | Total | 92,120 |
| Distribution Network Main | | Operation Cost | 0 |
| | L=996,100m | Maintenance Cost | 59,766 |
| | | Total | 59,766 |
| House Connection | | Operation Cost | 0 |
| | Water Meter Only N=228,300nos. | Maintenance Cost | 41,094 |
| | Service Pipe and Water Meter N=228,300nos. | Maintenance Cost | 27,396 |
| | | Total | 68,490 |
| Total | | Purchased Water Fee | 643,860 |
| | | Operation Cost | 0 |
| | | Maintenance Cost | 220,376 |
| | | Total | 864,236 |

## Table A125.1.6 Operation and Maintenance Cost of Sewerage System

| Item | Description | | Year 2016 |
|---|---|---|---|
| Trunk and Branch Sewer | | Operation Cost | 0 |
| | Branch Sewer DN10inch L=269,300m | Maintenance Cost | 8,079 |
| | Trunk Sewer DN12 - DN84inch 1,750×1750 Box Culvert L=17,440m | | 1,620 |
| | | Total | 9,699 |
| | | Total | 9,699 |
| TP-1 Sewage Treatment Plant | Capacity 24MGD | Operation Cost | 41,024 |
| | Mechanical and Electrical Equipment | Maintenance Cost | 1,443 |
| | | Total | 42,467 |
| TP-2 Sewage Treatment Plant | Capacity 54MGD | Operation Cost | 36,892 |
| | Mechanical and Electrical Equipment | Maintenance Cost | 863 |
| | | Total | 37,755 |
| Total | | Operation Cost | 77,916 |
| | | Maintenance Cost | 12,005 |
| | | Total | 89,921 |

# APPENDIX – A125.2

## Sewer Cleaning Cost

## A125.2 Sewer Cleaning Cost

| | | |
|---|---|---|
| Total sewer length | 1000 | km |
| Percentage of sewer to mechanically clean | 20 | % |
| Length of sewer to mechanically clean | 200 | km |
| Percentage of sewer to manually clean | 80 | % |
| Length of sewer to manually clean | 800 | km |

| | | |
|---|---|---|
| (1) Length of sewer to mechanically clean | 200 | km |
| Frequency of cleaning | 0.2 | time/year |
| Length to clean every year | 40 | km/year |
| Length to clean per machine per day | 100 | m/machine/day |
| Working days per week | 5 | days |
| Working days per year | 260 | days |
| Required machine on duty | 2 | units |
| Standby machine | 1.0 | unit |
| Total | 3 | units |
| Number of personnel for each machine | 6 | persons/unit |
| Number of personnel required | 18 | persons |
| Unit salary per person | 392,000 | Rs./person/year |
| | | (weighted average of one Rank-2 and two Rank-3) |
| Personnel cost per year | 7,056,000 | Rs./year |
| Total cost per year | 10,080,000 | Rs./year |
| | | (personnel cost accounts for 70% of the total) |

| | | |
|---|---|---|
| (2) Length of sewer to manually clean | 800 | km |
| Frequency of cleaning | 0.2 | time/year |
| Length to clean every year | 160 | km/year |
| Working days per week | 5 | days |
| Working days per year | 260 | days |
| Cleaned sewer by one party per day | 70 | m/party/day |
| Number of personnel per party | 5 | persons-party |
| Number of party required | 9 | parties |
| Number of personnel required | 45 | persons |
| Unit salary per person | 392,000 | Rs./person/year |
| | | (weighted average of one Rank-2 and two Rank-3) |
| Personnel cost per year | 17,640,000 | Rs./year |
| Total cost per year | 19,600,000 | Rs./year |
| | | (personnel cost accounts for 90% of the total) |

| | | |
|---|---|---|
| (3) Total cost for cleaning of trunk/branch sewers in a year | | |
| | 29,680,000 | Rs/year |
| (4) Unit cost for cleaning sewers per km per year | | |
| | 30 | Rs./m/year |

**Conclusion** **30 Rs./m/year**

# APPENDIX – A126.1

## Environmental Impact Assessment Report (Draft) for the Priority Project of the Study on Water Supply and Sewerage System in Karachi in the Islamic Republic of Pakistan

## A126.1 Environmental Impact Assessment Report (Draft) for the Priority Project of the Study on Water Supply and Sewerage System in Karachi in the Islamic Republic of Pakistan

### Table of Contents

# Chapter 1 Introduction

## 1.1 OBJECTIVE OF THE ENVIRONMENTAL IMPACT ASSESSMENT STUDY

The purpose of the Environmental Impact Assessment (EIA) is to ensure that development options under consideration are environmentally and socially sound and sustainable and that the environmental consequences of the project are recognized early and taken into account in the project design. The procedure should follow the Pakistan Laws, and JICA's Guidelines for Environmental and Social Considerations are also taken into account.

The major objective of this study is to establish present environmental and social conditions of the project area through available data / information to predict the impacts on relevant environmental and social attributes due to the construction and operation of the proposed water supply system and sewerage system, to suggest appropriate and adequate mitigation measures to minimise / reduce adverse impacts and to prepare an environmental impact assessment report. This study has been carried out on the priority project in Karachi city.

## 1.2 BACKGROUND

The JICA Study Team is assisting the KW&SB to consider the environmental and social aspects of this study. The role of the JICA Study Team is to:
Help the KW&SB implement the proper environmental and social considerations,
Prepare an effective Master Plan and select priority project which will not cause significant negative environmental or social impacts.
Assist the KW&SB to consult with stakeholders when preparing the Master Plan and conducting the Feasibility Study to foster support for the projects.
Ensure the positive information disclosure for accountability and promotion of participation of various stakeholders.

From the above situation, the EIA Study concerning the priority project shall be carried out in this Study. However, EIA Study done in this study is taken as EIA Study (Draft) for the following reasons.

**Stakeholder Meetings**

In this JICA Study, three stakeholder meetings (in the early Study stage, the Master Plan stage and the Feasibility stage) were planned in consideration of implementation of EIA Study. If it is under ordinary circumstances, the broad opinion acquired in stakeholder meetings is reflected into the priority project plan. Consequently, the priority project can be formulated with more residents' involvement.
The first stakeholder meeting was held in September 2006. The second stakeholder meeting was proposed to be held at the end of the Master Plan stage to inform of contents of the Master Plan and result of environmental and social considerations in the Master Plan to the stakeholders. JICA discussed the holding of second stakeholder meeting with KW&SB as the KW&SB should take necessary steps to organise the meeting. As the K-IV project and S-3 Project, the former is under PC-1 process and the latter is under pre-qualification stage of consultants, are included in the M/P, KW&SB was reluctant to disclose the information to the public at this stage. Therefore, the stakeholder meeting to inform of the contents of the Master Plan and results of environmental and social considerations was not held. By postponing the 2nd stakeholder meeting, 3rd meeting is not held yet.

**Land Acquisition**

There are some components with land acquisition in the priority project. However, actual location of land to acquire is not determined yet.

The above-mentioned two items are very important when implementing the priority project. Since these items are not determined at present, the EIA Study in this study may not include all the required items. As mentioned above, EIA has to carry out by the time of project implementation. Prior to EIA report preparation, necessary land has to be acquired and stakeholder meetings have to be held.

# Chapter 2 Legal and Administrative Framework

## 2.1 LEGAL AND ADMINISTRATIVE FRAMEWORK

### (1) Laws and Regulations

The major laws and regulations relative to the environmental and social consideration are as listed below:

#### a. Pakistan Environmental Protection Ordinance, 1983

The Ordinance for the first time established the Pakistan Environmental Protection Council and the Federal and Provincial Environmental Protection agencies. It also pioneered in the Pakistan, the requirement of preparing Environmental Impact Assessment (EIA) reports.

#### b. Pakistan Environmental Protection Act (PEPA) 1997

The Pakistan Environmental Protection Act 1997 is the most important environmental legislative instrument in Pakistan. This Act aims to provide for the protection, conservation, rehabilitation and improvement of the environment, for the prevention and control of pollution and promotion of sustainable development.

### (2) Administrative Framework

#### a. Pakistan Environmental Protection Council (PEPC)

PEPC was established in 1984 by Pakistan Environmental Protection Ordinance, 1983, headed by Prime Minister and one of the members is Minister of Environment. Its main roles are:

Co-ordinate and supervise enforcement of the provision of Pakistan Environmental Protection act,

Approve comprehensive national environmental policies and ensure their implementation,

Approve the National Environmental Quality Standards.

#### b. Pakistan Environmental Protection Agency (PEPA)

PEPA exist under the PEPC. PEPA is the regulatory institution entrusted with the functions of administering and enforcing the Act and its rules and regulations. These include:

Take all necessary measures for the implementation of the national environmental policies,

Ensure the enforcement of the National Environmental Quality Standards,

Establish standards for the quality of environment,

Establish systems and procedures for survey, surveillance, monitoring, measurement, examination, investigation, research, inspection and audit to prevent and control pollution.

#### c. Environmental Protection Agency of Government Sindh (SEPA)

In each province, Provincial Environmental Protection Agency (Provincial-EPA) is established, and Provincial-EPA is independent agency from Ministry of Environment and PEPA. Many of the federal agency's functions and powers have already been delegated to the Provincial-EPAs.

The main functions are advising & coordinating with government, semi-government organizations, industries, NGOs, and various development agencies on preventive measures for abatement of pollution.

Coordination environmental policies and plan,
Implementing PEPA, 1997 and entering NEQS,
Rendering advice and assistance on environmental matters to various agencies,
Establishment of monitoring system for effluents and emissions.

**(3) EIA Procedures**

Article 12 of Pakistan Environmental Protection Act 1997 states that no proponent of a project shall commence construction or operation unless he has filed with the Government Agencies designated by Federal Environmental Protection Agency or Provincial Environmental Protection Agencies, as the case may be, or, where the project is likely to cause an adverse environmental effects an environmental impact assessment shall be conducted, and he obtained from the Government Agency approval in respect thereof.

The legal procedures for IEE and EIA are promulgated in July 2000 (The Review of Initial Environmental and Environmental Impact Assessment Regulations, 2000). The regulations define the required procedures for "Policy and procedures for the filing, review and approval of environmental assessment" including responsibilities of EPA and other concerned agencies. (See **Figure A126.1.1**)

The Guidelines set out the key policy and procedural requirement, including a brief policy statement on the purpose of environmental assessment. The Guidelines also provide schedules of proposals that require either and IEE or EIA, which cover:

Initial environmental report (scoping, alternatives, site selection, format of IEE)
Assessing impacts (identification, analysis and prediction, baseline data)
Mitigation and impact management (and preparing an environmental management plan)
Reporting (drafting style, main features, shortcoming, other forms f presentation)
Review and decision-making (role, steps, remedial options, checks and balances)
Monitoring and auditing (systematic follow up, purpose, effective data management)
Project management (inter-disciplinary teams, programming & budgeting)

This water supply and sewerage project falling under the category specified in schedule II requires to file an EIA with the federal agency, i.e. Environmental Protection Agency, Sindh (EPA-Sindh). The procedures of EIA are as follows:

ToR for EIA
Selection of Consultants / Specialists
Field Visit and Report Preparation
Submission of the EIA report to the EPA-Sindh with review fee for EIA report
Confirmation of document submitted by the EPA-Sindh (within 10 working days)
Advertisement in the newspapers by EPA-Sindh (after 20-25 days of confirmation)
No objection certificate by the EPA-Sindh (within 90 days of filing)
Public Hearing (30 days after advertisement)

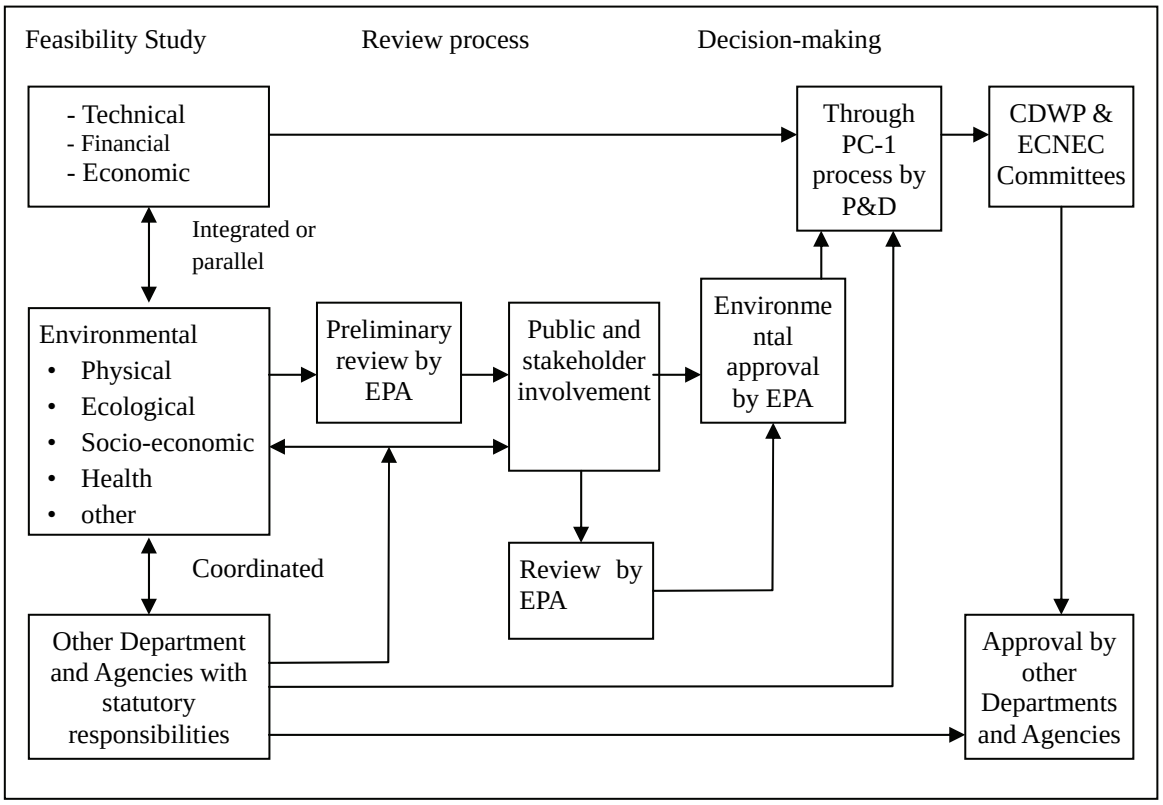



**Figure A126.1.1 Decision-making Process**

**(4) Information disclosure and stakeholders participation**

In principle, information on the environmental assessment is publicly disclosed. The policy of information disclosure and stakeholders participation is described under "Guidelines for Public Consultation, 1997, PEPA" which include:

Consultation, involvement and participation
Stakeholders
Techniques for public consultation (principles, levels of involvement, tools, building trust)
Effective public consultation (planning, stages of EIA where consultation is appropriate)
Consensus building and dispute resolution
Facilitating involvement (including the poor women, building community and NGO capacity)
Establish committee for the environmental evaluation

**(5) Land Acquisition Act and National Resettlement Policy**

The acquisition of private properties for public purposes including development projects in Pakistan is governed by the Land Acquisition Act 1894 (LAA). It comprises 55 sections pertaining to area notification and surveys, acquisition, compensation and apportionment, awards and disputes resolution, penalties and exemptions. Section 4 allows preliminary notification for survey, section 6 provides for declaration of intended acquisition, section 8 deals with detailed survey and planning, section 11 to 15 and 23 to 28 provide for inquiry by the Land Collector into claims and values, and the setting of compensation levels, primarily through interpretation of market value. Section 16 and 17 provide for compulsory acquisition, while section 18 allows for redress of grievance at the District level Civil Courts and above, if necessary.

In determining the amount of compensation shall take into consideration (i) the market value of the land at the date of the publication of the notification, (ii) the damage sustained by the taking of any standing crops or trees, (iii) the damage sustained by severing the land from his other land, (iv) the damage sustained by reason of the acquisition injuriously affecting his other property, moveable or immoveable in any other manner, or his earning, (v) if the person is compelled to change his residence or place of business in consequence of the acquisition of the land, the reasonable expenses incidental to such change, (vi) the damage resulting from diminution of the profits of the land between the time of the publication of the declaration and the time of the possession of the land. In addition to the market value of the land as above provided, the sum of fifteen percent on market value shall be awarded in consideration of the compulsory nature of the acquisition.

LAA has been the most commonly used law for acquisition of land and other properties for development projects. Although it lays down detailed procedures for the acquisition of private properties for public purposes and their compensation, the LAA dose not cover resettlement and rehabilitation of persons. Therefore, National Resettlement Policy has formulated in 2002 to ensure an equitable and uniform treatment of resettlement issues all over Pakistan. This Policy is applied to all development projects involving adverse social impacts, including land acquisition, loss of assets, income, business etc. The Policy also aims to compensate for the loss of income to those who suffer due to loss of communal property including common assets, productive assets, structures, other fixed assets, income and employment, loss of community networks and services, pasture, water rights, public infrastructure like mosques, shrines, schools, graveyards etc.

The objectives of the Policy are:

Avoid or minimize adverse social impacts in a project wherever possible and where adverse impacts cannot be avoided, the mitigation measures and resettlement activities should be conceived and executed as development programs and the affected persons be provided opportunity to share the project benefits,

Project affected persons be provided with sufficient compensation and assistance for lost assets, that will assist them to improve or at least restore their living standards, income earning or production capacity to the pre-project levels,

Provide a development opportunity to all vulnerable groups. The vulnerable population should receive special assistance to bring them at least to a minimum living standard at per with the pre-project level,

All population adversely affected by the project should be eligible for sharing the social and economic benefits, envisaged after completion of the project.

**(6) Others**

Other laws and regulations which may be related to the environment are:

Air Quality: Statutory Notification S.R.R.742 (1993)

Noise: The Motor Vehicle Ordinance (1965) and Rules (1965)

Toxic or Hazardous Substances: The Agricultural Pesticides Ordinance (1971) and Rules (1973)

## 2.2 ENVIRONMENTAL PROTECTION STANDARDS

### (1) Drinking Water Quality Standards

The Pakistan Council for Research in Water Resource (PCRWR) and Pakistan Standard Institution (PSI) have already drafted Drinking Water Quality Standards at national level. However, the enforcement of these standards is still pending and not approved yet. At present, KW&SB does not have its own water quality standards for drinking water. WHO guidelines for drinking water are adopted as desired value of water filtration processes. (See **Table A126.1**)

**Table A126.1.1 WHO Guidelines**

| **A. Bacteriological Qualities** | | | | | |
|---|---|---|---|---|---|
| Source/Organisms | | | Guideline Value | | |
| a. All water intended for drinking (E. Coli or thermo tolerant coliform bacteria) | | | Must not be detectable in any 100 ml sample | | |
| b. treated water entering the distribution system (E. coli or thermo tolerant coliform and total coliform bacteria) | | | Must not be detectable in any 100 ml sample | | |
| c. Treated water in the distribution system (E. Coli or thermo tolerant coliform and total coliform bacteria) | | | In the case of large supplies, where sufficient samples are examined, must not be present in 95 % of samples taken throughout any 12-month period. | | |
| **B. Chemicals of Health Significance** | | | | | |
| Inorganic | mg/l | Inorganic | mg/l | Inorganic | mg/l |
| Antimony | 0.005 | Copper | 2.000 | Molybdenum | 0.070 |
| Arsenic | 0.010 | Cyanide | 0.070 | Nickel | 0.020 |
| Barium | 0.7000 | Fluoride | 1.500 | Nitrate ($NO_3$) | 50.00 |
| Boron | 0.300 | Lead | 0.010 | Nitrite ($NO_2$) | 3.00 |
| Cadmium | 0.003 | Manganese | 0.500 | Selenium | 0.010 |
| Chromium | 0.050 | Mercury | 0.001 | | |
| **C. Other Parameters** | | | | | |
| Colour | 15 TCU | 1,2 dichlorobenzene | 1-10 | Hardness, pH | - |
| Taste, odour | - | 1,4-dichlorobenzen | 0.3-30 | DO | 0.05 |
| Turbidity | 5 NTU | Dichlorobenzen | 5-50 | Hydrogen | 0.3 |
| Toluene | 24-170 | Synthetic | - | Sulfide | 0.1 |
| Xylenes | 20-1800 | Detergents | 0.2 | Hydrogen | 0.3 |
| Ethyl-benzene | 2.4-200 | Aluminum | 1.5 | Manganese | 250 |
| Styrene | 4-2600 | Ammonia | 250 | Sodium | 1000 |
| Monochrolobenzen | 10-120 | Chloride<br>Copper | 1 | Sulfate<br>TDS<br>Zinc | 3 |
| **D. Disinfectants and Disinfectant by-Products** | | | | | |
| Chlorine chlorophenol | | 600-1000 | 2,4,6-trichlorophenol | 2-300 | |
| 2,4-dichlorophenol | | 0.3-40 | 2-chlorophenol | 0.1-10 | |

## (2) Effluent Standards

National Environmental Quality Standards for Municipal and Liquid Industrial Effluent is as below. (See **Table 126.1.2**)

**Table A126.1.2 Naional Environmental Quality Standards for Municipal and Liquid Industrial Effluent**

| S. No. | Parameter | Into inland water | Into sewage treatment[1] | Into sea[2] |
|---|---|---|---|---|
| 1. | Temperature | =< 3 | =< 3 | =< 3 |
| 2. | PH value | 6-9 pH | 6-9 pH | 6-9 pH |
| 3. | 5-days $BOD_1$ at 20 | 80 mg/l | 250 mg/l | 80 mg/l |
| 4. | COD | 150 mg/l | 400 mg/l | 400 mg/l |
| 5. | Total suspended solids | 200 mg/l | 400 mg/l | 200 mg/l |
| 6. | Total dissolved solids | 3500 mg/l | 3500 mg/l | 3500 mg/l |
| 7. | Grease and oil | 10 mg/l | 10 mg/l | 10 mg/l |
| 8. | Phenolic compounds | 0.1 mg/l | 0.3 mg/l | 0.3 mg/l |
| 9. | Chroride (as Cl) | 1000 mg/l | 1000 mg/l | SC |
| 10. | Fluoride (as F) | 10 mg/l | 10 mg/l | 10 mg/l |
| 11. | Cynide (as CN) total | 1.0 mg/l | 1.0 mg/l | 1.0 mg/l |
| 12. | An-ionic detergents(as MBAS) | 20 mg/l | 20 mg/l | 20 mg/l |
| 13. | Sulphate (SO4) | 600 mg/l | 1000 mg/l | SC |
| 14. | Sulphide (S) | 1.0 mg/l | 1.0 mg/l | 1.0 mg/l |
| 15. | Ammonia ($NH_3$) | 40 mg/l | 40 mg/l | 40 mg/l |
| 16. | Pesticides, herbicides, fungicides and insecticides | 0.15 mg/l | 0.15 mg/l | 0.15 mg/l |
| 17. | Cadmium | 0.1 mg/l | 0.1 mg/l | 0.1 mg/l |
| 18. | Chromium (trivalent and hexavalent) | 1.0 mg/l | 1.0 mg/l | 1.0 mg/l |
| 19. | Copper | 1.0 mg/l | 1.0 mg/l | 1.0 mg/l |
| 20. | Lead | 0.5 mg/l | 0.5 mg/l | 0.5 mg/l |
| 21. | Mercury | 0.01 mg/l | 0.01 mg/l | 0.01 mg/l |
| 22. | Selenium | 0.5 mg/l | 0.5 mg/l | 0.5 mg/l |
| 23. | Nickel | 1.0 mg/l | 1.0 mg/l | 1.0 mg/l |
| 24. | Silver | 1.0 mg/l | 1.0 mg/l | 1.0 mg/l |
| 25. | Total toxic metals | 2.0 mg/l | 2.0 mg/l | 2.0 mg/l |
| 26. | Zinc | 5.0 mg/l | 5.0 mg/l | 5.0 mg/l |
| 27. | Arsenic | 1.0 mg/l | 1.0 mg/l | 1.0 mg/l |
| 28. | Barium | 1.5 mg/l | 1.5 mg/l | 1.5 mg/l |
| 29. | Iron | 8.0 mg/l | 8.0 mg/l | 8.0 mg/l |
| 30. | Manganese | 1.5 mg/l | 1.5 mg/l | 1.5 mg/l |
| 31. | Boron | 6.0 mg/l | 6.0 mg/l | 6.0 mg/l |
| 32. | Chlorine | 1.0 mg/l | 1.0 mg/l | 1.0 mg/l |

1: Applicable only when and where sewage treatment is operational and BOD=80 mg/l is achieved by the sewage treatment system.
2: Provided discharge is not at shore and not within 10 miles of mangrove or other important estuaries

# Chapter 3 Project Description

## 3.1 COMPONENTS OF THE MASTER PLAN

### (1) Water Supply System

The following tables show the components of the Master Plan for the Karachi water supply system. (See **Table 162.1.3** and **Table 162.1.4**) The proposed facilities of upper 3 lines of the **Table 162.1.3** (bulk water canal/conduit, bulk pumping station, filtration plant) are proposed by KW&SB as K-IV project, Greater Karachi Water Supply Scheme (Executive Summary, May 2007).

**Table 162.1.3 Components of Bulk Water Supply System**

| Facility | Proposed | Rehabilitation/ Replacement |
|---|---|---|
| Bulk Water Canal/Conduit | 780 mgd | 620 mgd |
| Bulk Pumping Station | 6 P/Ss | 15 P/Ss |
| Filtration Plant | 5 F/Ps : 835 mgd | 6 F/Ps: 435mgd |
| Transmission Pumping Station | 7 P/Ss | 2 P/Ss |
| Transmission Main | 129 km | 17 km |
| Distribution Reservoir | 8 nos. | 6 nos.<br>(8 nos.) |
| Distribution Pumping Station | 3 P/Ss | - |

Note: The proposed facilities in upper 3 lines are proposed by KW&SB as K-IV project, Greater Karachi Water Supply Scheme (Executive Summary, May 2007)
Number in parenthesis is expansion of capacity

**Table 162.1.4 Components of Retail Water Supply System**

| Facility / Zone | Proposed | | | | Rehabilitation/ Replacement | | | |
|---|---|---|---|---|---|---|---|---|
| | West | Central | East | Total | West | Central | East | Total |
| Trunk Distribution Main (km) | 406 | 364 | 152 | 922 | 273 | 259 | 153 | 685 |
| Distribution Network Main (km) | 2,539 | 3,152 | 2,349 | 8,041 | 3,751 | 4,208 | 1,220 | 9,179 |
| by DNI | - | - | - | - | 2,578 | 3,069 | 681 | 6,329 |
| by other than DNI | - | - | - | - | 1,173 | 1,139 | 539 | 2,850 |
| House Connection (×1,000) | 454 | 564 | 420 | 1,438 | 1,119 | 900 | 378 | 2,398 |
| by DNI | - | - | - | | 553 | 784 | 283 | 1,620 |
| by other than DNI | - | - | - | | 566 | 116 | 95 | 778 |

### (2) Sewerage System

The proposed sewerage system in 2025 is shown in the table below. (See **Table 162.1.5**)

**Table 162.1.5 Proposed Sewerage System in 2025**

| | TP-1 (extension) | TP-3 (existing) | TP-2 (extension) | TP-4 (new) |
|---|---|---|---|---|
| District area ($km^2$) | 145.3 | | 100.4 | 340.2 |
| Population | 8,849,000 | | 5,013,000 | 11,720,000 |
| Branch Sewer Length (km) | 3,300 | | 2,120 | 5,230 |
| Trunk Sewer Length (km) | 46 | | 48 | 121 |
| Number of main Pumping Station | 2 (Jamila, Chakiwara) | | 2 (Gulberg, Clifton) | 3 (Korangi, Bin Qasim, Karachi Port) |
| Location of TP | SITE Town | Keamari Town | Jamshed Town | Korangi Creek Cantonment |
| TP Site area (ha) | 49 | 221 | 49 | 168 |
| Capacity ($m^3$/d) (mgd) | 500,000 (110) | 245,000 (54) | 490,000 (108) | 1,290,000 (284) |
| Influent BOD (mg/l) | 600 | 600 | 600 | 600 |
| Effulent BOD (mg/l) | 80 | 80 | 80 | 80 |
| Sewage Treatment Process | UASB + HRTF | Wastewater stabilization pond | UASB + HRTF | UASB + HRTF |
| Sludge Treatment Facilities | GT + MD | DB | GT + MD | GT + DB / MD |
| Treated Sewage Discharge Point | Lyari River | Arabian sea (swamp area of Karachi Bay) | Malir River | Malir River |

Note: UASB for upflow anaerobic sludge blanket, HRTF for high rate trickling filter, GT for gravity thickening, DB for drying bed, MD for Mechanical dewatering,

## 3.2 COMPONENTS OF THE PRIORITY PROJECT

The priority project selected three towns of North Nazimabad, Gulberg and Liaquatabad Towns in western zone of Karachi City to improve water supply and sewerage system from the Master Plan, and the priority project consists of water supply and sewerage systems. Components of the priority project for water supply system are expansion of reservoir and improvement of distribution network. Components of sewerage system consist of collection / conveyance network implementation and replacement of equipment in the two associated sewage treatment plants. Components of the priority project are shown in **Table 126.1.5**.

**Table 126.1.6 Components of the Priority Project**

| | Components | Quantity | |
|---|---|---|---|
| Water Supply System | Expansion of reservoir (NEK old reservoir) | Capacity (million gallons) | 30 |
| | Rehabilitation of Trunk Distribution Mains | Pipe length (m):<br>Diameter (inch): | 25,990<br>16 - 100 |
| | Installation of Trunk Distribution Mains | Pipe length (m):<br>Diameter (inch): | 49,490<br>14 - 64 |
| | Installation of Flow Mete | Flow mete (nos) | 17 |
| | Rehabilitation of Distribution Network Mains | Pipe length (m)<br>North Nazimabad Town:<br>Gulberg Town:<br>Liaquatabad Town:<br>Total | <br>336,600<br>374,900<br>284,600<br>996,100 |
| | Improvements to House Connections | **Water meter only**<br>North Nazimabad Town:<br>Gulberg Town:<br>Liaquatabad Town:<br>Total<br>**Water meter and service pipe**<br>North Nazimabad Town:<br>Gulberg Town:<br>Liaquatabad Town:<br>Total | <br>8,800<br>9,200<br>2,100<br>20,100<br><br>68,600<br>71,500<br>68,100<br>208,200 |
| Sewerage System | Rehabilitation of Collection & Trunk Sewers | Pipe length (m):<br>Pipe diameter (inch):<br>Box culvert (mm) | 36,570<br>15 – 84<br>1,750 × 1,750 |
| | Rehabilitation of Sewage Treatment Plant (TP-1) | Pumps and other equipment | - |
| | Rehabilitation of Sewage Treatment Plant (TP-3) | Pumps and other equipment | - |

## 3.3 JUSTIFICATION OF THE PRIORITY PROJECT

Since the priority project is a part of the Master Plan, there is no alternative study about the priority project itself. The alternative study of the Master Plan is summarized below.

### (1) Analysis of Alternatives (Master Plan, Water Supply System)

#### a. Project Benefits and Positive Impacts

The main objectives of the water supply project are to improve the living condition, public health, standards of living and to encourage economic growth. Therefore, the project is expected to have the following benefits and positive impacts.

Expanded water supply service areas,
Increased amount of water distribution and continuous water supply,
Improvement of water quality supplied,
Reduced non-revenue water including water leakage,
Increased economic activities (such as commercial and industrial), improved employment opportunities, and economic growth,
Improvements to public health which will then result in higher economic activity and productivity,
Increased local employment opportunities during the construction phase of the project, either as direct labor for construction or as provide services at the construction sites.

#### b. With/Without Project

With the project, the benefits and positive impacts mentioned above will be expected. If the project is not implemented, the situation could be as follows.

Severe water shortage will be happen as the population in Karachi City is increasing in future,
The leakage rate will remain high and the big amount of water will be wasted,
The public health condition will become worse due to water shortage.

**c. Alternative of Water Source**

The alternatives of water sources are rivers, groundwater, desalination and reuse of treated effluent. There is very little and irregular precipitation in Karachi, it is therefore very difficult to use local surface water as a source of water supply in Karachi.

The Karachi District area comprises four basin areas, namely Malir River Basin, Gadap Basin, Lyari River Basin, and Hub River Basin. The groundwater exists in these basins and the aquifer is available in different depths of different strata. The groundwater is recharged manly by precipitation which falls in the watershed area of the basins. Since the major streams and nallahs are ephemeral in natures, most of the precipitation is lost through surface runoff.

The request for additional 1,200 cuses intake from the Indus River is already made by CDGK and KW&SB to Federal government and this will be most possible new water sources for Karachi water supply.

Desalination can be an option to obtain another water source, but its cost is huge. One desalination plant (3 mgd = 13,500 $m^3$/d) is under construction by DHA. The conclusion still remains effective even at present and most likely it will continue to remain valid in foreseeable future.

The treated effluent from TP-3 and Pakistan Still Mill treatment plant is used as plant watering and sprinkle water to golf course. The effluent with $BOD_5$ 80 mg/l, which is the effluent standards of Pakistan, is not appropriate to use as water sources.

**d. Alternative for Water Transmission System**

In M/P, it is proposed to divide Karachi into three hydraulic zones each separated from the others by two major rivers i.e. Malir and Lyari Rivers. Within each zone, the alternatives for water transmission system are discussed. In each zone, three alternatives of distribution system are compared in terms of cost and difficulty in operation.

**(2) Analysis of Alternatives (Master Plan, Sewerage System)**

**a. Project Benefits and Positive Impacts**

The main objectives of the sewerage project are to improve the living environment, public health and hygiene, standards of living and to encourage economic growth. Therefore, the project is expected to have the following benefits and positive impacts.

Improvement of the water quality of the rivers/sea by collection and treatment of sewage prior to its discharge to river/sea and improvement of the river/coastal water environment,

Reduced risks of diseases by a proper collection, treatment and disposal of sewage, and enhancement of the human health,

Improvement of sanitation conditions in the cities,

Increased economic activities (such as commercial and industrial), improved employment opportunities, and economic growth,

Improvements to public health which will then result in higher economic activity and productivity,

Increased local employment opportunities during the construction and O/M phases of the project, either as direct labor for construction and O/M stages or as provided services at the sites.

**b. With/Without Project**

With the project, the benefits and positive impacts mentioned above will be expected. If the project is not implemented, the situation could be as follows.

Untreated sewage will continuously contaminate receiving bodies such as nallah, rivers and sea,

The public health condition will become worse due to continuous drain and river water contamination and the health risk will be increased,

The sea/coastal water environment will get worse.

**c. Alternative Study for Sewerage System**

The three alternatives for sewerage system are studied from technical, economic, environmental and social viewpoints.

Alternative 1 has technical advantage of adoption of energy saving process but the river crossing of the trunk sewer is necessary. Alternative 2 has the advantage that no river crossing of the sewer is necessary but more efficient process which requires higher energy consumption and sophisticated operation skills should be adopted and cost for construction and O&M becomes higher. Alternative 3 requires additional land acquisition for TP-5 (75 ha).

Comparing 3 alternatives, it is concluded that alternative 1 is recommended from technical, economical, environmental and social viewpoints.

**(3) Justification of the Priority Project**

If the priority project is not implemented, the current problems will remain unsolved will be further deteriorated with an increase of population in the future. If the priority project is implemented, the existing problems will be solved.

The existing problems in the project area, and benefits of the implementation of the priority project are shown in **Table126.1.7**.

**Table 126.1.7 The Problems and Benefits without/with the Priority Project**

| The Existing Problems (without Project) | Benefits with the Priority Project |
|---|---|
| Water Supply System | |
| Water supply service level is low.<br>Actual service hour (the majority of the population only receives water for a few hours supply every 3 to 4 days.)<br>Since water supply water pressure is low, private storage tank and suction pump are required.<br>Since water pressure is low, ingress of polluted water to the distribution pipe is expected.<br>In order to compensate the amount of insufficient water supply, water supply by a tanker is performed.<br>House connection has many unsuitable facilities because of private responsibility. | All households receive water supply service.<br>Service hour is 24 hours a day and seven days a week.<br>Sufficient water pressure is maintained. Therefore, the private storage tank and the suction pump will be unnecessary. The ingress of polluted water to the distribution pipe is not expected.<br>All households receive the appropriate water supply service. Consequently, water supply by tanker will be unnecessary.<br>All of house connection facilities are reconstructed by the priority project. |
| The capacity of distribution line is insufficient.<br>There is very high ratio of leakage and non-revenue water. (Average ratio of leakage: 30 – 35 % as the study area)<br>It is possible that without the implementation of the DNI leakage could increase to 60 to 70%. | All households receive water supply service.<br>Improvement is expected. |
| Many residents of Karachi have a very negative impression of KW&SBB and the service it provides and are therefore reluctant to pay water charges.<br>While the basic cost of piped water in Karachi may be cheap, the indirect costs associated with its use are unreasonable high.<br>With increase in population, the existing problems are aggravated further. | Water meter installation and introduction of a meter-charge system<br>Improvement in the rate of charge collection<br>A financial improvement is prospective.<br>Improvement in water-saving consciousness<br>Improvement is expected. |
| Sewerage System | |
| The existing sewage collection ratio: 90 %<br>The capacity of collection and conveyance sewer is insufficient. | The whole quantity of sewage will be collected and the sewage can be conveyed to the sewage treatment plant. |
| The existing treatment plants are not functional. | The treated effluent will meet the effluent water quality standards. |

# Chapter 4 Baseline of Environmental Data

## 4.1 PHYSICAL ENVIRONMENT

### (1) Topography

Karachi City represents quite a variety of habitats such as the sea coast, islands, sand dunes, swamps, semi-arid regions, cultivated fields, dry stream beds, sandy plains and hillocks. Classified according to physiographic features, Karachi City District can be divided into three broad categories:

Hilly region

Alluvial plain

Coastal areas

The metropolitan area is divided into two river streams namely Lyari and Malir Rivers. Gujjar and Orangi are the main tributaries of the Lyari River while Thaddo and Chakalo are the main

tributaries of the Malir River. Among the various physiographic features, low flat-topped parallel hills devoid of vegetation, interspersed with sidespread plains and dry riverbeds are the main topographic characteristics of the city. The highest of the region is 75 m that gradually decreases to 1.5 m above mean sea level towards the coastline.

**(2) Geology and Geomorphology**

The present geological set-up of the city is largely composed of sandstone, shale of Nari, Gaj and Mancher formation ranges from Oligocene to recent. The study area comprises the hills, valleys and the coast as the physical features. Rocks are deposited under shallow marine to deltaic condition. On the basis of the water bearing properties, the lithostratigraphic units can be classified as consolidated and un-consolidated sediments. The project area extends in the north to south east direction, sloping towards the Arabian sea. Physiographical classification of the area establishes three separate landforms, namely mountain highland, piedmont plain and the valley floor. According to the geological classification, the rocks of the entire region of Karachi and its suburbs, upper valleys of Lyari and Malir rivers are almost exclusively of the tertiary deposit belonging to the most recent geological period. The lower reach of the Lyari basin constitutes post-tertiary alluvial subsoil while the upper reach constitutes boulders and conglomerate. Malir River basin consists of alluvial deposits of boulders, gravels, sand and clay.

**(3) Climate**

As located on the coast, Karachi tends to have a relatively mild climate, with low average levels of precipitation (approximately 175 mm per year), which classifies the region as arid. The hottest month is May-June with the temperature ranging between 32 ºC and 35 ºC, the winter is relatively mild and with dry minimum temperatures of about 7 ºC. For most parts of the year, the relative humidity in Karachi is high. In the morning it ranges from 53 to 86 % and in the afternoon it ranges between 53 and 81 %. The relative humidity is at a minimum in the months of March to June while it is at highest during the monsoon months of July through September. (See **Table 126.1.8** and **Table 126.1.9**)

**Table 126.1.8 Monthly Rainfall in Karachi (Airport) from 1948 to 2004**

Unit: mm

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1948 | - | 38.9 | 35.1 | - | - | 32.5 | 47.5 | 1.0 | - | - | - | 12.4 | 167.4 |
| 1949 | 0.3 | - | 0.5 | - | - | - | 159.4 | 212.9 | 1.3 | - | - | - | 374.4 |
| 1950 | 15.2 | - | - | - | - | - | 117.6 | 2.5 | 1.3 | - | - | - | 136.6 |
| 1951 | - | - | - | 2.3 | - | - | 39.9 | 33.3 | 1.3 | - | - | - | 76.8 |
| 1952 | Trace | 35.1 | Trace | - | - | 0.3 | 160.5 | 0.5 | 24.6 | Trace | - | 3.3 | 224.3 |
| 1953 | 1.8 | - | - | - | - | 41.1 | 1.8 | 210.3 | - | - | - | 7.1 | 262.1 |
| 1954 | 18.8 | 30.0 | - | - | - | 0.5 | 55.6 | 34.3 | 150.4 | - | - | - | 289.6 |
| 1955 | 10.4 | 12.7 | 0.3 | - | - | 0.8 | 0.3 | 30.7 | 96.3 | 0.8 | - | 3.3 | 155.6 |
| 1956 | 21.8 | - | - | 4.4 | Trace | 43.4 | 157.7 | 89.2 | Trace | 98.0 | - | Trace | 414.5 |
| 1957 | 3.3 | - | - | 5.1 | - | - | 16.9 | 6.6 | - | - | 4.1 | 5.3 | 41.3 |
| 1958 | 6.6 | 2.5 | - | - | - | - | 131.3 | 0.3 | 32.0 | - | 1.3 | 57.1 | 231.1 |
| 1959 | 3.8 | 2.5 | - | - | - | 0.8 | 234.9 | 46.7 | 315.7 | Trace | 83.1 | 1.3 | 688.8 |
| 1960 | 2.3 | - | 32.5 | - | - | - | 43.7 | 28.4 | - | - | - | 22.6 | 129.5 |
| 1961 | 17.8 | 53.8 | - | 11.7 | - | 16.8 | 168.1 | 185.7 | 166.4 | - | - | 1.5 | 621.8 |
| 1962 | - | - | - | - | - | - | 81.3 | 42.7 | 148.6 | - | - | 6.1 | 278.7 |
| 1963 | - | - | - | 1.8 | - | - | 1.8 | 9.9 | - | - | 30.2 | - | 43.7 |
| 1964 | 2.0 | 5.1 | - | - | - | 2.5 | 77.0 | 49.0 | 3.0 | 1.5 | - | - | 140.1 |
| 1965 | - | - | - | 3.3 | - | - | 107.7 | 18.5 | - | - | - | - | 129.5 |
| 1966 | - | - | 1.5 | - | - | 0.3 | 68.3 | - | - | - | - | - | 70.1 |
| 1967 | - | - | 130.0 | 24.4 | - | 11.2 | 429.3 | 98.8 | - | - | 5.1 | 14.2 | 713.0 |
| 1968 | 11.4 | 4.8 | - | - | - | 0.8 | 0.5 | 5.3 | - | - | - | 6.1 | 28.9 |
| 1969 | - | 1.0 | - | - | - | - | 38.4 | - | - | - | - | - | 39.4 |
| 1970 | 7.1 | 7.1 | 62.2 | - | - | 5.1 | 151.9 | 155.2 | 86.4 | - | - | - | 475.0 |
| 1971 | 3.0 | - | - | - | - | - | 33.3 | 30.5 | - | - | - | 1.0 | 67.8 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1972 | - | 3.3 | - | - | - | 20.8 | 16.0 | - | - | - | - | 4.1 | 44.2 |
| 1973 | - | - | - | - | - | - | 184.9 | 20.1 | - | - | - | 8.4 | 213.4 |
| 1974 | - | 0.6 | - | - | - | - | - | 0.4 | - | 0.6 | - | 5.6 | 7.2 |
| 1975 | 13.7 | 21.3 | 30.2 | - | - | 0.3 | - | 76.9 | 21.1 | - | - | - | 163.5 |
| 1976 | 66.8 | 10.1 | 30.7 | 0.0 | 0.0 | 0.0 | 217.2 | 36.5 | 44.8 | 0.0 | 0.0 | 0.0 | 406.1 |
| 1977 | 10.3 | 0.0 | 0.0 | 2.3 | 0.0 | 34.8 | 302.6 | 44.8 | 88.5 | 0.0 | 5.2 | 0.0 | 488.5 |
| 1978 | 14.3 | 4.7 | 0.0 | 0.0 | 0.0 | 6.8 | 179.4 | 175.5 | 0.1 | 0.0 | 5.7 | 0.0 | 386.5 |
| 1979 | 1.7 | 96.0 | 0.0 | 0.0 | 0.0 | 3.4 | 0.0 | 262.5 | 0.0 | 3.9 | 0.0 | 13.5 | 381.0 |
| 1980 | 0.0 | 0.0 | 10.9 | 0.0 | 0.0 | 43.2 | 45.0 | 0.4 | 0.0 | 23.8 | 6.9 | 63.6 | 193.8 |
| 1981 | 0.0 | 25.0 | 37.4 | 3.6 | 0.0 | 0.0 | 40.2 | 43.4 | 0.0 | 0.0 | 0.0 | 0.0 | 149.6 |
| 1982 | 2.1 | 24.9 | 0.0 | 0.0 | 0.0 | 0.0 | 27.7 | 105.5 | 0.0 | 0.0 | 0.0 | 1.0 | 161.2 |
| 1983 | 0.0 | 3.7 | 0.0 | 38.5 | 0.0 | 0.0 | 54.7 | 159.1 | 25.5 | 0.0 | 0.0 | 0.0 | 281.5 |
| 1984 | 0.3 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 19.4 | 245.7 | 4.0 | 0.0 | 0.0 | 0.0 | 270.0 |
| 1985 | 0.9 | 0.0 | 0.0 | 17.6 | 0.0 | 0.5 | 80.6 | 25.0 | 0.0 | 0.0 | 0.0 | 0.0 | 124.6 |
| 1986 | 0.0 | 0.8 | 11.4 | 0.0 | 0.0 | 17.0 | 0.0 | 62.4 | 0.0 | 0.0 | 0.0 | 0.0 | 91.6 |
| 1987 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1988 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 74.0 | 85.0 | Trace | 0.0 | 0.0 | 0.0 | 160.0 |
| 1989 | 0.5 | 8.3 | 1.5 | 0.0 | 0.0 | 0.0 | 166.8 | 4.3 | 0.0 | 0.0 | 0.2 | 3.5 | 185.1 |
| 1990 | 25.3 | 23.5 | 0.0 | 0.0 | 0.0 | 0.4 | Trace | 78.7 | 7.7 | 0.0 | Trace | 1.8 | 137.4 |
| 1991 | 3.0 | 19.5 | 2.0 | 0.0 | 0.0 | 0.0 | Trace | Trace | Trace | 0.0 | 0.0 | 0.0 | 24.5 |
| 1992 | 19.4 | 8.0 | 0.9 | 0.0 | 0.0 | 0.0 | 83.9 | 138.2 | 22.6 | 0.0 | 0.0 | 0.0 | 273.0 |
| 1993 | 7.0 | 11.8 | 0.0 | 0.0 | 0.0 | 0.0 | 8.4 | Trace | Trace | 0.0 | 8.3 | 0.0 | 35.5 |
| 1994 | 2.2 | 2.5 | 0.0 | Trace | 0.0 | Trace | 256.3 | 147.8 | 61.7 | 0.0 | 0.0 | 11.0 | 481.5 |
| 1995 | 89.3 | 5.2 | 0.2 | 0.0 | 0.0 | Trace | 157.9 | 6.2 | 0.0 | 0.0 | 1.0 | 0.0 | 259.8 |
| 1996 | 13.0 | 33.2 | 9.6 | 0.0 | 0.0 | 30.0 | 12.8 | 0.4 | 0.0 | 0.0 | 0.0 | Trace | 99.0 |
| 1997 | 13.4 | Trace | 20.8 | 3.6 | 5.0 | 16.6 | 18.6 | 27.5 | 30.0 | 9.9 | 3.0 | 4.4 | 152.8 |
| 1998 | 9.1 | 4.3 | 4.9 | 0.0 | 0.0 | 28.0 | 10.6 | 0.5 | 0.0 | 25.6 | 0.0 | 0.0 | 83.0 |
| 1999 | 6.5 | 1.8 | 1.8 | 0.0 | 0.2 | Trace | 2.0 | Trace | 0.0 | 4.0 | 0.0 | 0.0 | 16.3 |
| 2000 | 19.0 | 3.0 | 0.0 | 0.0 | Trace | 0.0 | Trace | 24.9 | Trace | 0.0 | 0.0 | 0.0 | 46.9 |
| 2001 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 10.6 | 73.6 | 16.2 | Trace | 0.0 | 0.0 | 0.0 | 100.4 |
| 2002 | 0.0 | 2.4 | 0.0 | 0.0 | 0.0 | Trace | 0.0 | 52.2 | Trace | 0.0 | 0.5 | 0.4 | 55.5 |
| 2003 | 6.4 | 21.9 | 0.0 | 0.0 | 0.0 | 16.3 | 270.4 | 9.8 | Trace | 0.0 | 0.2 | 0.0 | 325.0 |
| 2004 | 13.7 | 0.0 | 0.0 | 0.0 | 0.0 | Trace | 3.0 | 5.6 | Trace | 39.3 | 0.0 | 4.3 | 65.9 |

Source: Pakistan Meteorological Department

**Table 126.1.9 Mean Monthly Temperature**

Unit: ºC

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1996 | 18.0 | 21.1 | 25.9 | 28.8 | 30.9 | 32.3 | 30.7 | 28.3 | 28.7 | 28.4 | 23.5 | 19.7 | 26.4 |
| 1997 | 18.4 | 21.3 | 24.6 | 25.4 | 29.9 | 31.2 | 31.4 | 30.3 | 29.8 | 27.9 | 24.7 | 19.7 | 26.2 |
| 1998 | 19.4 | 20.8 | 25.8 | 29.9 | 32.0 | 32.4 | 30.7 | 29.6 | 31.0 | 29.3 | 25.2 | 21.9 | 27.3 |
| 1999 | 11.9 | 22.3 | 26.6 | 30.0 | 31.2 | 31.4 | 30.1 | 29.4 | 29.7 | 30.3 | 26.2 | 21.4 | 26.7 |
| 2000 | 19.5 | 21.4 | 25.6 | 30.0 | 30.9 | 31.7 | 30.4 | 29.2 | 29.5 | 29.6 | 25.7 | 21.5 | 27.1 |
| 2001 | 19.4 | 22.3 | 26.4 | 29.2 | 31.6 | 32.3 | 29.6 | 29.4 | 29.5 | 36.0 | 26.0 | 23.1 | 27.9 |
| 2002 | 19.9 | 21.0 | 26.4 | 29.6 | 31.3 | 31.6 | 29.5 | 28.3 | 28.0 | 29.4 | 25.1 | 21.4 | 26.8 |
| 2003 | 20.1 | 22.7 | 26.1 | 30.3 | 30.6 | 31.4 | 30.9 | 29.7 | 28.9 | 28.9 | 23.7 | 20.1 | 26.9 |
| 2004 | 19.7 | 22.2 | 27.7 | 30.2 | 32.0 | 32.1 | 30.6 | 29.5 | 29.0 | 28.1 | 24.3 | 22.4 | 27.3 |
| 2005 | 18.6 | 20.8 | 25.9 | 29.1 | 30.9 | 32.3 | 30.3 | 29.4 | 30.4 | 29.0 | 26.0 | 20.7 | 27.0 |

Source: Pakistan Meteorological Department

### (4) Wind Pattern

Strong coastal winds are the characteristic feature of the region. The wind direction during the southwest monsoon period is dominantly from the northeast and wind intensity is depending on the air pressure of the continent. The effect of this air pressure is also felt on the Karachi cost where the winter air pressure is 1018 hectopascal in January and summer air pressure is 998 hectopascal in July. Mean wind velocity varies from 5.3 miles per hour (m.p.h, 8.5 km / hour) in November to 12.8 m.p.h. (20.4 km/hour) in July. Remarkably strong winds blow mostly from southwest or west during from March till October. In the coastal regions, the wind velocities reach up to 25 m.p.h. (40 km / hour). (See **Table 126.10** and **Table 126.11**)

**Table 126.1.10 Mean Monthly Wind Speed at Noon**

Unit: knots

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1996 | 4.6 | 5.0 | 7.4 | 7.9 | 9.2 | 10.8 | 9.4 | 8.6 | 8.9 | 7.0 | 6.4 | 4.7 | 7.5 |
| 1997 | 6.3 | 7.4 | 8.8 | 9.9 | 10.3 | 10.7 | 9.5 | 9.2 | 6.5 | 5.9 | 3.7 | 4.5 | 7.9 |
| 1998 | 2.8 | 6.7 | 6.5 | 3.7 | 8.8 | 11.3 | 10.7 | 9.9 | 7.5 | 6.4 | 4.9 | 4.6 | 7.0 |
| 1999 | 2.3 | 6.2 | 7.1 | 7.3 | 8.5 | 11.2 | 10.6 | 9.4 | 9.7 | 6.6 | 5.8 | 4.0 | 7.4 |
| 2000 | 6.4 | 6.7 | 8.4 | 10.9 | 11.0 | 13.0 | 12.4 | 10.3 | 10.5 | 7.5 | 4.9 | 4.1 | 8.8 |
| 2001 | 4.5 | 5.7 | 7.9 | 9.5 | 12.2 | 12.3 | 8.5 | 9.8 | 8.2 | 5.7 | 4.2 | 4.3 | 7.7 |
| 2002 | 6.0 | 7.0 | 8.6 | 10.9 | 12.6 | 9.1 | 14.1 | 9.7 | 11.0 | 5.8 | 5.6 | 5.2 | 8.8 |
| 2003 | 7.1 | 8.3 | 9.2 | 10.1 | 11.2 | 10.5 | 7.9 | 9.6 | 7.3 | 6.2 | 4.7 | 4.1 | 8.0 |
| 2004 | 6.3 | 7.2 | 7.2 | 10.1 | 11.9 | 12.2 | 12.5 | 11.9 | 9.4 | 6.7 | 3.6 | 4.9 | 8.7 |
| 2005 | 4.5 | 6.9 | 7.8 | 9.5 | 10.1 | 9.9 | 11.2 | 10.7 | 8.1 | 5.9 | 2.1 | 4.5 | 7.6 |

Source: Pakistan Meteorological Department

**Table 126.1.11 Mean Monthly Wind Direction at Noon**

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1996 | N17W | S51W | S72W | S62W | S96W | S82W | S88W | S82W | S69W | S85W | S14W | S02W |
| 1997 | N03E | S62W | S84W | S68W | S65W | S71W | S65W | S63W | S62W | S65W | S45W | S59E |
| 1998 | S81W | S60W | S59W | S61W | S66W | S60W | S71W | S76W | S66W | S52W | S43W | S21W |
| 1999 | S48W | S73W | S54W | S61W | S56W | S54W | S61W | S61W | S67W | S55W | S56W | S16W |
| 2000 | S56W | N60W | S60W | S57W | S58W | S73W | S67W | S58W | S54W | S54W | S47W | S39N |
| 2001 | S54W | S43W | S42W | S45W | S48W | S45W | S52W | S59W | S44W | S56W | S45W | S06W |
| 2002 | S67W | S52W | S51W | S55W | S51W | S42W | S54W | S45W | S48W | S56W | S54W | S41W |
| 2003 | S51W | S38W | S45W | S52W | S46W | S44W | S41W | S50W | S43W | S48W | S49W | N17E |
| 2004 | N27W | S46W | S53W | S49W | S52W | S54W | S54W | S62W | S56W | S47W | S45W | N86E |
| 2005 | N63W | S51W | S50W | S52W | S63W | S48W | S54W | S49W | S87W | S54W | S52W | N23W |

Source: Pakistan Meteorological Department

**(5) Water Sources**

Both surface and ground water sources are available and used in Karachi as water source. The following part describes main sources of surface and ground waters.

**a. Surface Water**

**Kinjar Lake**

It is the largest freshwater lake in Pakistan with very extensive reed-beds, particularly in the shallow western and northern parts. The lake is 24 km long by 6 km at its widest, and has an irregular shoreline of about 192 km. It was constructed in the 1930's from two smaller lakes, Kinjhar and Kalri, by the construction of a dam at Chilia Bangla and a 12 km long embankment along the east site. The maximum depth of the lake is 8 m.

**Haleji Lake**

It is located at 75 km east of Karachi in the Thatta district. It is a perennial freshwater lake with associated marshes and adjacent brackish seepage lagoons, set in a stony desert of limestone and sandstone bedrock. The lake was originally a saline lagoon formed by seasonal rainwater collected in a shallow depression. However, in the late 1930's the lagoon was converted into a reservoir to provide an additional water supply for Karachi. The saline water was drained out and embankments were constructed around the lake. The maximum depth is 5-6 m when fully flooded. The lake is about 3 km long and 1.6 km wide.

**Hub Dam**

The other principal source of surface water for Karachi is the Hub Dam. It is located 40 km west of Karachi, on the border between Baluchistan and the Sindh Provinces. It is a large reservoir constructed in 1981 next to the Hub River, on the arid plains north of Karachi. Harnessing of Hub River was completed long before the Independence. However, it was only after the creation of Pakistan that properly planned survey schemes were sanctioned for the utilization of water

from the Hub and Malir rivers. As a result, detailed investigation was conducted, Hub Dam was proposed to be built at the present site just before the confluence of the Shorin Nallah and the Hub River. Hub Dam has a catchment area of 3,410 square miles (8,832 $km^2$). However, because of low and variable rainfall in the catchment and high evaporation rates, both drinking water and irrigation demands are met only at the 80% level. The water level in the reservoir fluctuates widely according to rainfall in the catchment area; the maximum depth is 46 m and the average is 19 m.

**b. Groundwater**

Karachi city falls in a dry and arid zone with scanty and intermittent rainfall with prolonged period of drought.

The Karachi District area comprises four (4) basin areas, namely:
Malir River Basin
Gadap Basin
Lyari River Basin
Hub River Basin (partial)

The groundwater exists in these basins within the alluvial deposits of Quaternary age and Manchar conglomerate, sandstone, Gaj sandstone, limestone, Nari sandstone and silica sand. Groundwater aquifer is available in different depths of different strata. Semi artesian condition has also been identified in deeper confined aquifers. The depths of aquifers and the water table in Karachi ranges from 20 feet (6 m) to 300 feet (91 m) below ground surface. The groundwater is recharged mainly by precipitation which falls in the watershed area of the basins. Since the major streams and nallahs are ephemeral in natures, most of the precipitation is lost through surface runoff. Some of this water percolates into the subsoil strata and contributes to recharge of groundwater.

At present, the groundwater is withdrawn from the open wells and tube wells. About 1000 existing dug wells and tube wells are provided with centrifugal or submersible pumps. The average pumping discharge of these wells has been estimated approximately as 80 gallons per minute (363 litter / min) that amounts to a discharge of 53 cusecs (1.5 $m^3$) against an estimated recharge of 91 cusecs (2.6 $m^3$). The balance of approximately 38 cusecs (1.1 $m^3$) represents a rough assessment of the present potential availability of groundwater sources. This quantity is partly represented in groundwater flows for springs, evaporation, evapo-transpiration and base flows of sub-soil storage. In the past, ground water at Dumlottee location was a major source of water for Karachi. The Khadeji, Thaddo Nallah, Mole tributary are the main sources of recharge to the Malir Basin area. However, gradually with the passage of time and due to excessive lifting of sand from Malir River bed along with extensive use of ground water by farmers, the water table has dropped.

Continuous lowering of the water table is likely to result in intrusion of seawater into the Malir River Basin under natural seepage conditions and under induced conditions of recharge of saline seawater in the coastal aquifers of Karachi. This is an encroachment of the interface between seawater and freshwater, through intrusion and/or upcoming. Contamination by salty seawater can further increase the deterioration of the groundwater quality in the coastal aquifer.

There are some ground water sources along the coastal belt. However, the water is mostly saline and unsuitable for drinking. In many places within the Karachi coastal belt, groundwater is being used for domestic and household works and in some places the water is slightly saline. The areas where groundwater is used include the Cape Monze area, Buleji, Shamspir, Clifton and in areas adjacent to the Korangi Creek near the Rehri Village. Further inland, the sites include Mauripur, Lower Lyari area, around the Karachi Port, Kharadar, Methadar and Defence Housing

Authority. The water table near the Karachi coast is assessed to be between 3-7 feet (0.9-2.1 m) to 20-60 feet (6.1-18.3m) in the landward areas.

**c. Sea Water and Coastal Oceanography**

The Karachi coastal zone lies in the north-eastern corner of the Pakistan coast bordering the northern Arabian Sea. The coastal oceanographic features of the Karachi coastal zone are therefore very much under the influence of the oceanographic characteristics of the northern Arabian Sea. The unique oceanographic features of the northern Arabian Sea such as high salinity, low precipitation, high evaporation rates, reversal of sea water circulation during the two monsoon periods, and high primary production rates, prevail all along the coastal and near-shore waters of the Karachi coastal belt. However, due to the small depths of the in-shore and backwaters, certain factors such as turbulence, turbidity, high suspended solids, littoral drift and organic and inorganic pollutants are more pronounced in the coastal waters within the coastal zone of Karachi.

The annual range of sea-surface temperatures along the Karachi coast is 19 ºC to 31 ºC. The average variations of seawater salinity in the coastal waters usually range between 35,000 ppm to 37,000 ppm. The seawater salinities in the Karachi harbour generally range from 33,000 ppm to 37,000 ppm and are very much influenced by the input of freshwater discharged by the Lyari River. The seawater salinities in the greater part of the inter-tidal creeks of the Indus Delta near Karachi remain between 37,000 ppm to 41,000 ppm for the most part of the year. The seawater circulation pattern along the coast of Karachi can be grouped into three types, namely: clockwise circulation, anti-clockwise circulation and mixed circulation. The analysis of the long period tidal data recorded at Karachi Port reveals that the 'Mean Sea Level', is rising at a rate of about 1.1 mm/year. The waves on the coast vary with the seasons. Tides along the Karachi coast are semi-diurnal that is one tidal cycle, and diurnal inequality is also present. In the daily cycle there are two high waters and two low waters which vary considerably from each other in tidal heights. The speed of the seawater current is generally low, about 0.5 knot. The speed increases up to 1 knot during monsoon. The direction is directly related to the prevailing wind system.

**(6) Ambient Air Quality**

The main source of ambient air pollution in Karachi are vehicle emissions, waste burning, suspended solid and 'dirty fuels' for production purposes used by small scale businesses. Air pollution levels in Karachi and other urban centres of Pakistan are extremely high compared with the international standards and are rising every year. According to the Ministry of Environment, 40% of the urban population of Pakistan faces health risks from pollution.

In Karachi, recent air quality surveys indicate a positive correlation between the incidences of ailments/symptoms and ambient air pollution from the transport sector. Higher than acceptable levels of major category pollutants, pollutant levels considered very harmful to human health are being recorded in Karachi. These include: carbon monoxide, sulphur dioxide, nitrogen oxides, particulate matter and ozone. In the areas where air quality was measured, sources of pollution are mainly transport vehicles and three wheelers. (See **Table 126.12**)

**Table 126.1.12 Air Pollutant Level in Karachi City**

| Year | TSP ($\mu g/m^3$) | $PM_{10}$ ($\mu g/m^3$) | $NO_X$ (ppb) | $SO_2$ (ppb) | $O_3$ (ppb) | Methane (ppm) |
|---|---|---|---|---|---|---|
| 1999 | 210 | 164 | 16 | 11.7 | 11.2 | 0.5 |
| 2003 | 349 | 182 | 20.9 | 17 | 17 | 0.7 |
| 2004 | 374.5 | 194 | 28.8 | 24 | 18.8 | 6.5 |
| % Increase / Decrease from 1999 to 2004 | 78 | 18 | 80 | 105 | 68 | 1200 |

Source: SUPARCO Baseline Ambient Air Quality Studies; World Bank (2005)

**(7) Ambient Noise**

Karachi is the hub of industrial and commercial activities in Sindh. In 1994, a survey was done to assess the degree of noise pollution in Karachi. Noise analysis data was collected for 16 hour periods and carried out in 72 selected sites. The local train whistling up-to 113 db was the worst polluter. The National Logistic Cell (NLC) trawler emitting 96 db came next. Similarly, other forms of vehicular traffic such as motorcycle, three wheelers etc. were the main contributors to high levels of noise pollution in the city. Noise levels varying from 87 to 99db were recorded at the harbour and the vegetable/meat market areas. Even near places such as hospitals high noise levels (81 to 82 db) were recorded. It is felt that rapid urbanization is contributing to increasing levels of ambient noise in the city, particularly sources from various forms of vehicular traffic. Increase in the number of vehicles, traffic jams, lack of maintenance of vehicles, traffic jams all contribute to this growing pollution threat.

## 4.2 Biological Environment

**(1) Protected Areas and Sensitive Habitats/Reserves**

In Pakistan there exists a system of protected areas for the protection of endangered species, habitats, ecosystems, archeological sites, monuments, buildings and other cultural heritage. Protected areas in Pakistan can be broadly categorized into two groups, namely:

Ecosystems; and

Archaeological and cultural sites

Ecosystems include protected areas such as wildlife reserves, national parks, and game reserves. The official classification of notified protected ecosystem in Pakistan is i) National Park ii) Wildlife Sanctuary iii) Game Reserve. In addition, there are protected forests, village forests, and state forests. The main features of a 'National Park' include protection and preservation of scenery, flora, fauna in its natural state and preserving areas of outstanding scenic merit and natural forest. The main features of a 'Wildlife Sanctuary' include areas with undisturbed breeding grounds, prohibited or regulated public areas and areas prohibiting non-exploitation of forests. The government may, by notification in the official gazette, declare any area to be a wildlife sanctuary and may demarcate it in a manner as it sees fit. The government may declare an area as a 'Game Reserve' where hunting and shooting of wild animals is not allowed; except under a special permit, which may specify the maximum numbers of animals or birds that may be killed or captured in the area and the period for which such permits will be valid**.**

Archaeological sites and monuments are specifically protected by the Antiquities Act 1975, while the 'Guidelines for Sensitive and Critical Areas' of the Pakistan Environmental Protection Act 1997 focus on the protection of the existing sites. New sites may also be notified through the federal or provincial archaeology departments**.**

**(2) Bio-diversity – Fauna and Flora**

**a. Coastal Bio-diversity**

The vegetation along the Karachi coast is dominated by mangrove forests. Eight species have

been documented with *Avicennia marina* being the most abundant (95%). Dense mangroves are present in the Korangi and Phitti creeks. This ecosystem provides habitat for wildlife of terrestrial and marine origin. The mammals of the mangrove forest include tropical dolphins, porpoises and occasionally visitors such as toothed whales. Little information is available on the reptiles, however, three species of lizards, one species of poisonous snakes and two species of marine snakes have been reported. The common fauna and flora of the relatively less polluted areas within the backwaters of Karachi include the gastropod *(Poteamides cinglatus)*, the barnacles *(Balanus amphitrite, Euraphia withersii)*, mud skipper fish *(periophthalmus dussemerie)*, the fiddler crab (Uca lacteal), the sea weed *(Entermorpha intestinales, Ulva reticulates)***.**

The sandy shores of the Karachi coast has four main groups of macro marine organisms, namely, crabs, gastropods, interstitial fauna and cast off sea weed along the high water zone as well as floating near the coastal waters. The Hawks Bay and Sandspit beaches are one of the most important green turtle *(Chelonya mydas)* nesting sites in the world. The coastal creeks and backwaters attract a number of migratory birds, particularly water fowl (for details see section on Wetlands). The pelagic fauna of the creeks near Karachi includes fishes, *Siphonophores* and *Ctenophores*. The pelagic flora includes floating sea weeds. The demersal fauna of the area includes shrimps and demersal fish.

**b. Land based vegetation**

The characteristic vegetation on the 'Hills' in Karachi are *xerophytic*, growing on the slopes as well as on the hills. *Inula granteoides* is the most common species found on the top of the hills. Next to it are *Blepharis scindia, Aristida mutabilis* and *Aristida adscenions*. Shrubs like *Commiphora wightii, Euphorbia caducifolia, Crewia tenax* and *Grewia villosa* are the major constituents of the vegetation on the slopes. Northern and north-eastern sides of the hills show better vegetation growth as compared to the southern and western exposures.

On the 'Alluvial Plain', vegetation is composed of deciduous *xerophytic* shrubs, forming open communities. A few of them are progressing towards climax, while others remain under various physiographic and edaphic control. The pioneer plants are *Corchorus depressus, Launaea nudicaulis, Salvia santolinifolia, Fagonia Arabica, Tibulus terrestris, Zygophyllum simplex, Cucumis prophetarium, Sida ovata* alongwith the grasses *Aristida mutabilis* and *Eleusine compressa* followed by herbs of *Cassia holosericea, Cassia senna, Aerva javanica* and *Indigofera oblongifolia.*

On the 'Dry Stream Beds' around Karachi, pioneer species are *Pteropyrum oleveri, Rhazya stricta* which are found in the heart of the dry stream beds because these two plants comparatively require shallow water depth. These plants are followed by *Nerium odorum* which is succeeded by *Gymnosporia Montana, Rhus mysorensis,* and *Tamarix articulate,* on the either sides of the dry banks, plants of *Rhus mysorensis, Acacia jacquemonti* and *Gymnosporia Montana* nurse the seedlings of *Eiphorbia caucifolia* which later on dominates over them.

The land in Karachi also supports vegetation in the 'Cultivated Fields'. Near Manghopir are found sulphur springs and sweet water streams. The area gives an appearance of an oasis. Date palm groves are dominant, besides date palm *Ricinus communis, Vinca rosea* and some vegetables are also commonly grown. *Euphorbia tirucalli* is commonly grown as shelterbelts around the cultivated fields. In Malir where sweet sub-soil water is available, vegetable and fruit trees grow by the help of tube-well irrigation. The common fruit trees grown here are *Mangifera indica, Phoenix sylvestris, Carica papaya, Psidium gaujava, Zizyphus jujube, Musa sapientum* and *Anona squamosa*. In addition, the Hub Dam area and Gadap are also vegetable growing areas.

**(3) Wetland Resources**

Some important wetlands located within and in the vicinity of Karachi city are discussed below;

**a. Kinjhar (Kalri) Lake**

The lake and surrounding areas are state owned (Government of Sindh). The site was listed as a 'Wetland of International Importance' under the 'Ramsar Convention', in July 1976, and declared a 'Wildlife Sanctuary', in March 1977 under Section 14 of the Sindh Wildlife Protection Ordinance 1972. Commercial fishing, domestic water supply for Karachi city, scientific research and public recreation are the dominant land uses. Unsustainable fishing activities constitute the major threat to the ecosystem**.**

**b. Haleji Lake**

The lake and the surrounding areas are state owned (Government of Sindh). The area was declared a 'Wildlife Sanctuary' (1,704 ha), in March 1977 under Section 14 of the Sindh Wildlife Protection Ordinance 1972. Haleji Lake Wildlife Sanctuary was listed as a 'Wetland of International Importance', in July 1976. Fishing and domestic water supply to Karachi City constitute the principal uses of the lake. Illegal fishing, hunting and increased situation and eutrophication are the major threats to the ecosystem.

**c. Hadero Lake**

It is located 85 km east of Karachi in the district of Thatta. The lake and stony desert to the north and west are state owned (Government of Sindh). The area was declared as a 'Wildlife Sanctuary' (1,321 ha), in March 1977 under Section 14 of the Sindh Wildlife Protection Ordinance 1972. Commercial/sport fishing and excavation of stone for road construction in the adjacent areas are currently practiced. Excessive fishing, illegal hunting and indiscriminate removal of superficial layers of limestone are the major threats to the ecosystem.

**d. Hub Dam**

The Dam is state owned while the adjacent areas are privately owned communal lands. Its reservoir is protected within the 'Hub Dam Wildlife Sanctuary' (27,219 ha), established in 1972. Fishing activities take place while the reservoir provides drinking water to Karachi city and water for irrigating agricultural land in Lasbella District, Baluchistan. Fishing activities cause some disturbance to waterfowl population and the Dam has had detrimental effects on the ecology of the downstream of the estuarine system. The Dam is considered to have the highest fishery potential among the smaller reservoirs in Pakistan.

**e. Hawks Bay/Sandspit Beaches and adjacent creeks**

The beaches are located on the coast southwest of Karachi City. They are gently sloping sand beaches with open sandy offshore approaches stretching for about 20 km along the Arabian Sea coast west from Manora Point at the mouth of Karachi harbour, and there are a complex of creeks and shallow tidal lagoons with extensive inter-tidal mudflats and some mangrove swamps behind the beach. The eastern part of the beach (Sand spit) is all sand and the western part (Hawks Bay) has some rocky areas. The site is one of the regions of most important green turtle nesting site. The green turtles are recognized as endangered species by the Sindh Government. Beach recreation is the main land use. There are many beach huts built along the beach and human usage of the beach resulting in generation of garbage (that attracts predators such as dogs/crows), night lightening etc. are having harmful effects on the nesting turtles and their hatchlings. In addition, the beach huts (often built in violation of the relevant building laws) are encroaching on prime turtle nesting space.

The adjoining creek system is one of the most important areas for wintering, passage and summering shorebirds in Pakistan, and also supports significant amount of cormorants, flamingos, ducks, gulls and terns.

### f. Clifton Beach

Located on the coast south of Karachi City, it is a long sandy beach with adjacent tidal mudflats, backed by sand dunes. The sand dunes have practically no vegetation on their seaward slope. Land use status is public recreational beach. Part of the mudflats have been lost as a result of dyke construction while significant amount of sewage from the Defence Housing Authority / Clifton Cantonment area is discharged directly to the Clifton beach, spoiling its environment and recreational value.

### g. Korangi and Gharo Creeks

The creeks are located about 20-30 km southeast of Karachi, at the northern extremity of the Indus Delta. The site is a complex of large tidal creeks with extensive mangrove swamps and inter-tidal mudflats, near the southeastern outskirts of Karachi. The creek system was originally developed as a part of the Indus Delta, but is no longer hydraulically connected to the delta. The tidal range is about 2m. The creeks are state owned and under the administration of the Port Qasim Authority. Surrounding areas are privately owned. An area of 80,743 ha, including 48,286 ha of mangroves, has been declared as a 'Protected Forest' and is managed by the Sindh Forest Department. Grazing by domestic livestock in the mangroves, the cutting of mangrove branches for cattle fodder, and fishing are the principal uses. The creeks provide a supply of water for nearby industries and are uses as a transportation network. There are several large industrial developments, many fishing villages and a port in the area. The mangrove ecosystem is of considerable importance as a breeding and nursery ground for many species of fish and shrimps of economic value. The two major threats to the area are pollution (mostly sourced from the nearby industrial establishments) and over-exploitation of natural resources.

## 4.3 SOCIO-CULTURAL ENVIRONMENTAL

### (1) Population

It is now estimated that Karachi's population is approximately 13 million (9.8 million in the 1998 census). Currently an estimated 350,000 persons are added to the population every year. Another estimate puts the increase at 33,000 households annually. The city contains close to 33% of the population of Sindh and 7.5% of the population of Pakistan. In the early period of Karachi's growth, after the creation of Pakistan, migration played an important role. This trend continued over the years. (See from **Table 126.13** to **Table 126.15**)

**Table 126.1.13 Karachi's Population Growth**

| Year | Population | Increase/Decrease Over Last Census / Survey | No. of Years in Between | Percent Increase / Decrease | Average Annual Growth Rate |
|---|---|---|---|---|---|
| 1941 | 435,887 | 135,108 | 10 | 44.90 | 3.70 |
| 1951 | 1,137,667 | 701,780 | 10 | 161.00 | 11.50 |
| 1961 | 2,044,044 | 906,377 | 10 | 79.70 | 6.05 |
| 1972 | 3,606,746 | 1,562,702 | 11 | 76.50 | 5.00 |
| 1981 | 5,437,984 | 1,831,238 | 9 | 50.80 | 4.96 |
| 1998 | 9,802,134 | 4,540,422 | 17 | 86.29 | 3.52 |

Source: Government of Pakistan Census Reports.

**Table 126.1.14 Population of Municipal Corporations and Cantonment Areas by Sex (1998 Census)**

| Municipal Corporations / Cantonment areas | Total | Male | Female |
|---|---|---|---|
| Municipal Corporation East. | 2,612,158 | 1,392,079 | 1,220,079 |
| Cantonment area Faisal Drigh Road | 133,856 | 72,281 | 61,575 |
| Municipal Corporation west | 1,899,566 | 1,038,346 | 861,220 |
| Manora Cantonment | 10,008 | 6,036 | 3,972 |
| Municipal Corporation South | 1,504,461 | 807,619 | 696,842 |
| Karachi Cantonment & Clifton Cantonment | 240,577 | 135,746 | 104,831 |
| Municipal Corporation Central | 2,277,931 | 1,200,536 | 1,077,395 |
| Municipal Corporation Malir | 447,282 | 254,767 | 192,515 |
| Malir Cantonment & Korangi Creek Cantonment | 78,641 | 47,485 | 31,156 |

Source: Development Statistics of Sindh, 2003

**Table 126.1.15 Population of Katchi Abadi**

| | 1970s (1978) | 1980s (1985) | Most Recent (1988) | 2000 (Projection) |
|---|---|---|---|---|
| Katchi abadi population | 2,000,000 | 2,600,000 | 3,400,000 | 7,070,000 |
| No. of Katchi abadi Households | 227,000 | 356,000 | 465,000 | 960,000 |

Source: Karachi Land and Housing Study: Dr. D. Dowall/KDA-MPD, 1989.
Shelter for Low Income Communities: Inception Report on Sindh: World Bank, October 19990

## (2) Land Use and Urban Planning

### a. Land

In 1870, the urbanized area of the Karachi District was 13 sq.km, the 1971 census report gives the figure of 289 sq.km, the 1974 Master Plan defined metropolitan Karachi as 349 sq.km and the 1988 Karachi Development Plan gives a figure of 3,520 sq.km. The area of Karachi District is 3,527 sq.km. At the current rate of urban land conversion of about 6,780 acres (27 $km^2$) per year, Karachi will outstrip its present boundaries.

In Karachi, nearly 400,000 acres (1,618 $km^2$) of the 425,000 acres (1,719 $km^2$) makes up its metropolitan area and account for 94% of all land in the district are in some form of public ownership. Land for development is transferred from the Government of Sindh to the city development agencies that plan and develop land as per their rules and regulations and make plots available to private developers, cooperative societies and individuals for construction purposes. These development authorities also set aside land for social and physical infrastructure development and for commercial and recreational purposes. In addition to formal sector development, there is a lot of informal development. Around 1000 acres (4.0 $km^2$) of government land is encroached upon for developing squatter settlements (Katchi Abadis) each year. Almost 50% of the city population lives in these Katchi Abadis.

### b. Urban Planning

The key urban master planning exercises carried out for Karachi City are briefly discussed below:

**The Karachi Development Plan 2000**

On the expiry of the 1974-85 Karachi Master Plan period, the Karachi Development Plan 2000 was initiated by the KDA with UNDP assistance. The plan document was completed in 1990. Essentially the plan consisted of a computer model that would monitor developments in Karachi so that investments could be directed appropriately. It also contained important recommendations for planning and a related institutional set-up which included the setting up of an independent Karachi Division Physical Planning Agency (KDPPA) supported by a steering committee and an implementation board. Building control in this agreement was to be subject to the KDPPA. However, the monitoring and related planning exercise could not be carried out

without a constant supply of data for which no system was proposed by the plan. This and other related factors rendered the entire set-up created for the Karachi Development Plan 2000 ineffective. In addition, the plan was never authorised as its Steering Committee could not meet to approve it.

**Master Plan 2020 for the Development of Karachi**

A project for the formulation of a Master Plan 2020 for Karachi City is presently being carried out within the Master Plan Group of Offices (MPGO) of the City District Government Karachi (CDGK). The present planning exercise focuses on updating conditions, improving the technical tools, adding new tools to planning, new spatial planning, change of land use, relationship between land use and zoning regulations, rate of growth of squatter settlements and change in urban profile, etc.

### (3) Transport and Traffic

Karachi has 14,854 intra-city buses, all owned by private operators. In addition, it has 513 inter-city buses as well. These buses do not have proper terminals, workshops or depots for their use. There are also 13,613 taxis and 23,337 rickshaws in the city. According to the Regional Transport Authority (RTA) figures, 72% of all commuters using buses travel by Karachi's 8,773 mini-buses. The mini-buses are owned by individuals. Karachi's traffic is the main cause of air and noise pollution in the city. Much of the heavy traffic is related to port based activities. Because of the problems with the piped network in Karachi and the urgency of the water demand, water tanker deliveries now comprise as much as 25% of all water supply in the city, delivering about 95 MGD and constituting a major component of the daily traffic load in the city. It is estimated that about 4000 'general public' tanker deliveries are made per day to un-served and water scarce areas of the city.

The railway system in Karachi comprises the main line which runs from Keamari through Karachi City, Karachi Cantonment, Landhi, Bin Qasim and to the rest of Pakistan.

### (4) Socio-economic Activities

#### a. Health

Karachi has a variety of medical facilities. It has all sorts of hospitals, clinics and dispensaries, both in the public and private sectors. However, a vast majority of the population also get treatment from medical practitioners, both qualified and unqualified and by hakims (traditional doctors using herbal medicines). Most of these doctors operate from small, one room clinics and have no proper diagnostic facilities. There is no record of the number of such clinics. However, they greatly outnumber the formal sector health facilities. This is particularly the case in informal settlements. According to one survey, there are over 400 private clinics in Orangi and only 18 government and proper formal sector health facilities.

#### b. Education

In Karachi, according to the 1981 census, the literacy rate was 57% as compared to 26% in the whole Pakistan. According to a survey conducted by the Applied Economic Research Centre (AERC) in 1987, the literacy rate in the planned areas was 76% and 48.6% in unplanned areas. The Government of Sindh, the federal government, the City Government and the private sector are the main providers of education in Karachi. However, owing to the inadequacy of the government educational facilities, such facilities have been greatly supplemented by the private sector.

Social indicators representing the whole of Karachi may be misleading since there are major differences between the social indicators for the city's planned areas and Katchi Abadis. There are also major differences in social indicators among low-income settlements themselves. The data also shows that better incomes do not necessarily mean better social indicators.

**c. Economy**

Karachi is the financial capital of Pakistan; it has the greatest share of GDP and generates approximately 65% of the national revenue. Karachi has Pakistan's largest port, and it was the federal capital for the first two decades after independence. Estimates from the mid 1980's reveal that Karachi has made considerable contribution to the economy of the country. Karachi's per capita income is two and a half times that of the national average. In terms of large scale manufacturing industry, for example, Karachi still has a share of around one third in the national value added for the sector. In terms of contribution to the energy sector (electricity and gas), the transport, communication and storage sector, as well as the wholesale and trade sector, Karachi's contribution in each of these areas is at least 25% of the country's value addition.

The footprint of the corporate multinationals is on the increase in Pakistan and headquarters of a majority of the large corporate players are based in Karachi. For example, the headquarters of all the multinational banks operating in Pakistan (14 out of a total of 39 commercial banks operating in Pakistan) are located on the Wall Street of Karachi – the I.I. Chundrigar Road. A high percentage of the population also works in the informal sectors. However, unemployment is still over 10% and income disparities are quite prominent. Almost 50% of the population lives in squatter settlements (Katchi Abadis) with limited access to public utilities and gainful employment opportunities.

**(5) Solid Waste Management**

Karachi does not possess a properly functioning garbage management system. Garbage is often dumped in nallahs, open drains and sewer manholes, thus clogging the system, causing sewage overflows and system breakdowns.

Karachi generates about 6,113 tons of solid waste every day. About 5,057 tons is collected and 1,057 tons is not collected. About 10% of this waste is removed at source by housewives and sold to about 15,000 *kabaris* who pick up the waste from households. This solid waste consists of glass, plastic, metal and paper. In addition, another 600 tons of solid waste is collected from *kutchra kundis* and from the streets and markets by waste pickers. This waste consists of paper, rags, plastic, metal objects, glass and bones.

Sweepers employed by the municipal agencies or hired by residents, provide door-to-door garbage collection service. From the households, the waste is taken to neighbourhood collection points (concrete/steel bins) stationed at roadsides, on pathways, in parks and playgrounds. The garbage may also be dumped openly in storm drains, parks/playgrounds, back lanes etc. In such places, garbage is either burnt or is collected by the municipal agencies and transported to the landfill sites located in the outskirts of the city, one at Jam Chakro, Surjani Town and the other at Gond Pass, Hub River Road, 30-35 km from the city centre.

In the absence of any officially provided service in the recycle/reuse of solid waste, the informal sector has filled this gap to a great extent. The informal sector comprises of an organized chain of actors, starting from the rag pickers on the streets to the recycling factory owners. It is a flourishing business, which at a conservative estimate, accounts for 15%-20% of the total generated waste of the city. This sector provides employment to more than 55,000 families and had an annual turnover of Rs.1.2 billion. More than 1,000 recycling units are operative in the informal sector.

About 2.7 tons of waste is generated by 200 hospitals having total number of beds of 9,000. It contains 540 kg hazardous waste and 2,160 kg non-hazardous waste. For disposing of hospital waste, some private and government run hospitals have installed imported/locally developed waste incinerators. The City District Government has also installed two waste incinerators in the city. They cater only for the waste of about 140 health care units and are presently running at

very low efficiency.

In the areas not covered by the City Government such as the cantonment areas, Clifton, Malir, Faisal and Korangi cantonments there are 34 vehicles that collect an estimated 311 tons of garbage each day, which incurs a daily cost of Rs.197, 000 for sweeping and transportation. (See **Table 162.1.16**)

**Table 126.1.16 Solid Waste Management Statistics**

| Town | Waste generated Tons per day | Waste Lifted Tons per day | Waste Lifted Unattended / Backlog |
|---|---|---|---|
| Gadap | 350 tons | 320 tons | 30 tons |
| Korangi | 360 tons | 272 tons | 88 tons |
| Malir | 280 tons | 270 tons | 10 tons |
| Gulberg | 330 tons | 330 tons | Zero |
| North Nazimabad | 375 tons | 336 tons | 39 tons |
| Liaquatabad | 800 tons | 594 tons | 206 tons |
| Baldia | 400 tons | 302 tons | 98 tons |
| SITE | 167 tons | 153 tons | 14 tons |
| Landhi | 370 tons | 324 tons | 46 tons |
| North Karachi | 365 tons | 280 tons | 85 tons |
| Keamari | 220 tons | 180 tons | 40 tons |
| Shah Faisal | 105 tons | 105 tons | Zero |
| Orangi Town | 346 tons | 240 tons | 106 tons |
| Gulshan-e-Iqbal | 400 tons | 318 tons | 82 tons |
| Bin Qasim | 65 tons | 27 tons | 38 tons |
| Lyari | 350 tons | 300 tons | 50 tons |
| Jamshed | 330 tons | 252 tons | 78 tons |
| Saddar | 500 tons | 454 tons | 46 tons |

Source: Development Statistics of Sindh, 2003

**(6) Cultural Assets**

Karachi has a very rich built heritages. Most of them are located in the old city. The heritages consist of residential, public and institutional buildings such as hospitals, municipal offices, courts, prisons, halls, auditoriums, libraries, churches, schools and colleges and warehousing in the port area. Most of these buildings are of the early British period. Many of these heritages have been destroyed, both in the Saddar area and in the old city. Under the Sindh Cultural Heritage (Preservation) Act 1994, a large number of buildings (about 900) have been listed as protected buildings and their demolition is illegal under the Act. There are also a number of cultural sites in and around Karachi which record its long and complex history.

**(7) Water Rights**

The 'Constitution' of Pakistan protects the life of its people and obliges the State to secure the well being of the people and to provide for all the citizens, within the available resources of the country, facilitates for adequate livelihood and basic necessities of life. In 1994, the Supreme Court of Pakistan interpreted the constitutionally protected right to life and dignity to include the right to a healthy environment. Furthermore, the State is urged to promote, with special care, the economic interests of poorer classes or areas. According to the 'Constitution', water is a provincial subject. However, the Government of Pakistan has also to perform a number of functions and responsibilities in the water sector, mostly relating to inter-provincial matters. With regards to rights and interests in water, any individual has the right to complain about actual or proposed executive or legislative acts and failures of any authorities with respect to the use, distribution or control of water. With regard to the access to safe drinking water, the Supreme Court of Pakistan specified in another case in 1994, that mining companies have violated the rights of citizens by polluting local drinking water supplies. The Court expanded the Article 9 of

the right to life and said that it is a right to every person to have unpolluted water, wherever he lives.

**(8) Industrial Activities**

After the creation of Pakistan, the strategy adopted for industrialisation in the Sindh province promoted the creation of planned industrial estates and an engineering base. The first industrial estate established was the Sindh Industrial Trading Estate (S.I.T.E) beyond the Lyari River in Karachi in 1947, which was meant to be the industrial hub of the country, not just Sindh. S.I.T.E. was provided with infrastructure such as water, roads and a sewerage network with the specific condition that it would be used only if the effluent from the factories were treated according to the requirements of the Factory Act 1934. Industrial estates in Landhi (1953), Korangi (1959) and North Karachi Township (early 1970) were established subsequently. About 70% of the total industry of Pakistan is located in Karachi.

Nearly 30 MGD (136,000 $m^3$ / day) of water is being provided to industrial sites located at S.I.T.E, Korangi, Landhi, F.B Area, North Karachi and elsewhere in the city. However, none of the industrial estates in Karachi is served with effluent collection and conveyance system. So the effluents are not collected and conveyed to the KW&SB treatment plants and instead are discharged mostly untreated into the sea via the Malir and Lyari Rivers.

S.I.T.E covers an area of about 1,600 hectares and 2,000 industrial units. The effluents of S.I.T.E area are discharged into the Lyari River and ultimately into the Manora Channel of Karachi Harbour. The Landhi Industrial Trading Estate (L.I.T.E) and the Korangi Industrial Area discharge their effluents that include heavy metals, organic matter, oils, greases and a host of toxic chemicals into Malir River, that ultimately discharges them, along with domestic wastes, on the tidal flats of the Gizri Creek, from where the highly polluted waste water moves to the Arabian Sea.

# Chapter 5 Impact Identification and Mitigation Measures

## 5.1 OVERALL IMPACT IDENTIFICATION

The first step in EIA is to identify the potentially significant impacts. The various aspects considered in impact identification of the project are as follows:

- Project components
- Project stages
- Impact generating activities
- Type of impact

A matrix table was used to overall identify the impacts. The matrix thus identifies the environmental factors likely to be affected, and the activities responsible for this. The cells, which fall at the junction of an activity and an affected parameter, have been graded as A, B, C and blank. (See **Table 126.1.17**)

The adverse impacts have been classified in two categories, namely construction stage and operational stage. Impacts during construction stage may be regarded as temporary or short-term whereas those during operation stage are likely to have long-term effects. The environmental impacts have been discussed separately for the construction stage and the operational stage.

**Table 126.1.17 Scope Matrix for Project Components**

| Development Scheme | | | Affected parameters | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Social Environment | | | | | | | | | Natural Environment | | | | | | | | Pollution | | | | | | | |
| | Environmental Elements | | Resettlement | Economic Activity | Traffic/Public Facilities | Split of Communities | Cultural Properties | Water Right/Right of Common | Public Health Condition | Solid Waste | Hazard (Risk) | Topography and Geology | Soil Erosion | Groundwater | Hydrological Situation | Coastal Zone | Flora and Fauna | Meteorology | Landscape | Air Pollution | Water Pollution | Soil Contamination | Noise and Vibration | Ground Subsidence | Offensive Odor |
| Activities | Water Supply System | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Expansion of reservoir (NEK old reservoir) | cs | B | | C | | | | C | C | | | | | | | | | C | C | | | C | | |
| | | os | | | | | | C | | | | | | | | | | | C | | C | | C | | |
| | Replacement of trunk distribution main | cs | | C | B | | | | B | C | B | | | | | | | | C | B | | | B | | |
| | | os | | B | | C | | | | | | | | | | | | | | | C | | | | |
| | Installation of trunk distribution main | cs | | C | B | | | | B | C | B | | | | | | | | C | B | | | B | | |
| | | os | | B | | C | | | | | | | | | | | | | | | C | | | | |
| | Installation of flow meters /Flow control valves | cs | | C | B | | | | B | C | B | | | | | | | | C | B | | | B | | |
| | | os | | B | | C | | | | | | | | | | | | | | | C | | | | |
| | Installation of distribution main | cs | | C | B | | | | B | C | B | | | | | | | | C | B | | | B | | |
| | | os | | B | | C | | | | | | | | | | | | | | | C | | | | |
| | Installation of house connection | cs | | C | B | | | | B | C | B | | | | | | | | C | B | | | B | | |
| | | os | | B | | C | | | | | | | | | | | | | | | C | | | | |
| | Sewerage System | | | | | | | | | | | | | | | | | | | | | | | | |
| | Replacement of existing sewer line | cs | | C | B | | | | B | C | B | | | | | | | | C | B | | | B | | |
| | | os | | | | C | | | | | | | | | | | | | | | | | | | |
| | Installation of new sewer line | cs | | C | B | | | | B | C | B | | | | | | | | C | B | | | B | | |
| | | os | | | | C | | | | | | | | | | | | | | | | | | | |
| | Rehabilitation of Sewage Treatment Plant (TP-1) | cs | | | | | | | | C | | | | | | | | | | | | | | | |
| | | os | | | | | | | | C | | | | | | | | | | | C | | C | | C |
| | Rehabilitation of Sewage Treatment Plant (TP-3) | cs | | | | | | | | C | | | | | | | | | | | | | | | |
| | | os | | | | | | | | C | | | | | | | | | | | C | | C | | C |

Note:
cs: Indicates construction (rehabilitation) stage.
os: Indicates operation stage.

A: Indicates that the development scheme is foreseen to have strong impact on the environmental element.
B: Indicates that the development scheme is foreseen to have some impact on the environmental element.
C: Indicates the impact is not quite sure but minor impact is expected.

## 5.2 IMPACT IDENTIFICATION AND MITIGATION MEASURES

Adverse impacts and mitigation measures during construction stage and operation stage are summarized in **Table A126.1.19**, and items which are important or need explanation are described below.

**Expansion of Reservoir (NEK Old Reservoir) - Construction Stage, Water Supply System**

**Resettlement**

Impact:

Expansion of existing reservoir (NEK Old Reservoir) is proposed as the priority project component, and the land acquisition for expansion is necessary. Resettlement and disappearance of productive green /agricultural land may cause by land acquisition.

Mitigation Measures:

The NEK Old Reservoir is located in a suburb area of the north side of the Study Area. However, actual location of construction site is not determined yet. The existing boundary of water supply facilities area and an adjoining vacant area are shown in **Figure 126.1.2**.

Land owner of this vacant area is the Sindh Provincial Government, and there is no house and any facilities. If it is possible that the adjoining vacant area is able to acquire for the expansion project site, the level of adverse impacts caused by the land acquisition for the expansion of reservoir is expected not significant. The requirement of the land acquisition is shown in **Table 126.1.18**.

**Table 126.1.18 The Land Acquisition for the Expansion of Reservoir**

| Project Component | Capacity of Facility to be Expanded | Area Need to Acquire |
|---|---|---|
| Expansion of NEK Old Reservoir | 30 million gallons | 1.5 ha |

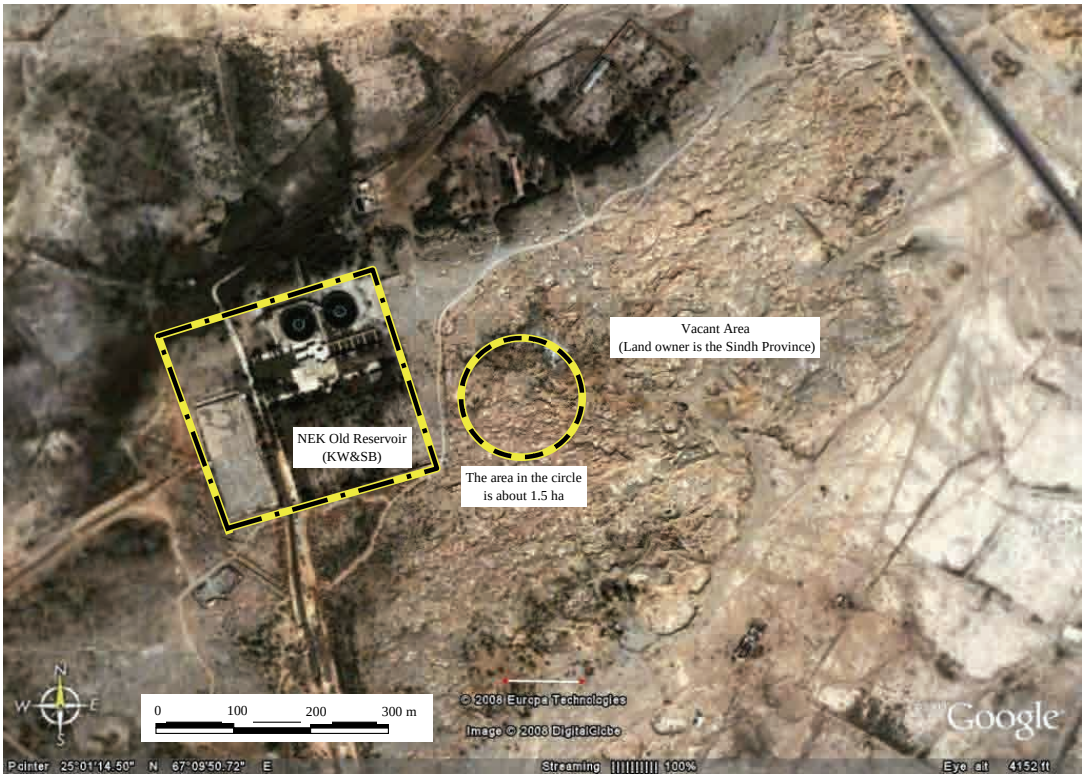



**Figure 126.1.2 The Suitable Site for the Expansion of Reservoir**

**Construction of Distribution Network - Construction Stage, Water Supply System**

Construction of distribution network is an integrated combination of the following

works:

Replacement of trunk distribution main
Installation of trunk distribution main
Installation of flow meters /Flow control valves
Installation of distribution main and line
Installation of house connection

**Traffic/Public Facilities**

Impact:

During the construction stage, serious disruptions of vehicular traffic and pedestrian, traffic jams, bottlenecks and blockages to roads will be expected.

During the construction of house connection, water supply may be partly disrupted for a certain period of time.

Mitigation Measures:

These impacts could be mitigated or minimized by the following countermeasures:

The announcement and public notification concerning the construction of facilities and its schedule before the construction.

As mitigation measures, during the construction period, watchman or traffic control staff will be deployed at the site to control the traffic, and schedule of the transport of construction material should be controlled.

Traffic diversion management should be properly implemented to control pedestrian movement.

Temporary fences with appropriate warning signs should be used to isolate the construction site. Especially, construction sites in the vicinity of schools, mosques and locations of public concentration should be strictly fenced.

If blockages to roads and other services are unavoidable, such blockage areas should be identified well in advance and circulate to public with appropriate details on maps.

During the construction stage, the project owner or building constructor should arrange an information desk and a person responsible at the construction site office.

When construction of house connection is carried out, constructor should inform the related household about preparation of water for drinking and domestic use. If necessary, the project owner should arrange sharing water with neighbours or water service by tankers.

**Hazard (Risk)**

Impact

The accident by the unapproved entry to the construction site can be considered.

It is said that about 50% of the existing distribution line in the Study Area uses an asbestos cement pipe. Respiratory organs illness by asbestos to workers and residents possibly occur by work such as cutting of asbestos cement pipe.

Mitigation Measures (Accident)

At the time of construction, the safety of public is one of the most important issues. Following combination of the activities increases the risks of accidents (especially local population) during construction stage:

Unauthorized access to a construction site
Absence of control over access to construction sites
Collision with construction vehicles
Poor site safety measures and warning system
Inadequate site management

Countermeasures such as fences with appropriate warning signs and personnel assignment against the above-mentioned items should be taken.

Mitigation Measures (Asbestos Cement Pipe)

In principle, the existing distribution line will be abandoned with the present condition. Consequently, the adverse impact at construction sites or move-out processes will be not generated.

When the work such as cutting of asbestos cement pipe is needed, it is required to work with careful attention to the following points.

Workers wear an anti-dust mask and working clothes, and these equipments is discarded after the end of work.

In principle, cutting work of the pipe is avoided as much as possible.

When cutting a pipe, it should be done after pouring water and making pipes wet.

The scob of cutting is kept in a container with a lid and should be incinerated.

The construction site forbids entry except the persons concerned.

When conveyance of an asbestos pipe is needed, it should be packed up with a plastic sheet and scattering of asbestos is prevented.

**Replacement of Existing Sewer Line & Installation of New Sewer Line - Construction Stage, Sewerage System**

It is desirable to construct sewers and water supply distribution networks simultaneously, which possibly reduces the whole adverse impacts by construction.

Work schedule and sequencing for combined construction works between sewers and water supply distribution networks should be considered. Normally, Sewers will be laid away from the water supply lines and at a greater depth.

Basically, adverse impacts during construction stage in sewage collection network are the same as these of distribution network for water supply except adverse impact concerning Asbestos Cement Pipe. Therefore, the possibility of the adverse impact is predicted concerning the following environmental elements.

Economic activity
Traffic /Public Facilities
Public Health Condition
Solid Waste
Hazard (Risk)
Landscape
Air Pollution
Noise and Vibration

Description of adverse impacts in the above environmental elements for the sewers (replacement of existing sewers and installation of new sewers) is omitted. (For details, refer to **Table 126.1.19**)

**Rehabilitation of Sewage Treatment Plants (TP-1 & TP-3) - Construction Stage, Sewerage System**

The rehabilitation of sewage treatment plants is only exchange work of equipment such as pumps, motors, sludge scraper, primary effluent sprinklers and electrical equipment with minor civil works. Therefore, it is expected that adverse impacts in the rehabilitation of sewage treatment plants are not significant to environmental and social aspects.

**Solid Waste**

Impact:

Solid waste is generated by replacement of equipment such as pumps and electrical equipment.

Mitigation Measures:

The generated solid waste is recyclable and valuable waste such as pumps and iron material.

**Expansion of Reservoir (NEK Old Reservoir) - Operation Stage, Water Supply System**

**Water Right/Right of Common**

Impact:

There may be a possible occurrence of adverse impact on the additional water right from the Indus River.

Mitigation Measures:

No additional water intake from Indus River is required till 2025.

**Construction of Distribution Networks - Operation Stage, Water Supply System**

**Economic Activity**

Impact:

The household which runs short of water or dose not have house connection receives water supply by a tanker that is operated by the Ranger. Therefore, if all the houses have connection and sufficient water can be supplied, water supply tankers will become unnecessary and business will be suspended. There might be possible unemployment of Rangers.

Mitigation Measures:

The water supply facilities will be constructed step by step till 2025, and the demand for water supply tankers will not decrease immediately. Moreover, it is expected that the rapid increase in population of Karachi city will increase the necessity for water supply tankers.

**Split of Communities**

Impact:

An obvious difference will arise in the water supply service level between adjacent towns and the project area by the implementation of this project.

Mitigation Measures:

Neighbouring towns are also included in the sole Master Plan. The opportunity to receive the same water supply service with the project area in the future is obtained. However, project area has a charge system equivalent to water supply service level.

**Rehabilitation of Sewage Treatment Plants (TP-1 & TP-3) - Operation Stage, Sewerage System**

**Offensive Odour**

Impact:

Emission of odour is expected from the sewage and sludge treatment processes in the sewage treatment plants.

Mitigation Measures:

Basically, it is expected that if the plants are operated and maintained properly, it is possible to control odor emission to the minimum. In addition, it is expected that adverse impacts will be reduced at the circumference environment of the sewage treatment plant.

The east and west side of the sewage treatment plant (TP-1) are surrounded is vacant, and the northern and southern areas are occupied by many factories.

Similarly, the sewage treatment plant (TP-3) is surrounded by factories, container yards and sea area. Therefore, the odour from these sewage treatment plants is not considered to cause the adverse impacts to local residents.

However, the odour monitoring at the boundary of the sewage treatment plants should

be carried out. According to the monitoring data, it can be judged that the circumference environment of the sewage treatment plants met environmental standards. It is recommended to accumulate the relevant data in the future.

**Table 126.1.19 Summary of Adverse Impacts and Mitigation Measures**

| | Environmental Items | Adverse Impact | Stage | Proposed Mitigation Measures |
|---|---|---|---|---|
| Water Supply System (Expansion of reservoir) | Resettlement | The land acquisition for expansion is necessary. Resettlement and disappearance of productive green /agricultural land may be caused by land acquisition. | Construction Stage | If it is possible that the adjoining vacant area is able to acquire for expansion project site, the level of adverse impacts caused by the land acquisition is considered not to be significant. |
| | Traffic/Public Facilities | During construction of the proposed reservoir, an increase of traffic volume and consequent traffic congestion will take place on the access road to the construction site due to vehicular movement for the transportation of construction material and residual soil. | | These effects could be mitigated or minimaized by the following countermeasures:<br>• The announcement and public notification concerning the construction contents and its schedule before the construction.<br>• Watchman or traffic control staff deployed at the site to control the traffic and scheduled transport of construction material.<br>• Arrangement of an information desk and deployment of a responsible person. |
| | Public Health Condition | The residents near the construction site may be affected due to increase of noise / vibration, deteriorated air and dust, etc by using construction vehicles and equipment. | | The effect will be temporary and their duration will not be long.<br>• Dust control through water sprinkling at the construction sites and access roads.<br>• Preventive maintenance of construction machineries and vehicles to meet emission standards.<br>• Attentive operation and speed restrictions of construction vehicles and equipment with sufficient effects on mitigation of adverse impacts. |
| | Solid Waste | The waste by construction of reservoir will be generated. The great portion of solid waste is residual soil from earth excavation work. | | The solid waste is recyclable for back filling. |

| | Environmental Items | Adverse Impact | Stage | Proposed Mitigation Measures |
|---|---|---|---|---|
| Water Supply System (Expansion of reservoir) | Landscape | Reservoir which is a construction structure may impress to the residents the landscape damage. | Construction Stage | The design which restricted the height of reservoir such as half-underground type or ground type is recommended. |
| | Air Pollution | Localized increase in dust due to excavation & earthwork and temporary increase in the levels of particulate matter (PM), Hydrocarbons (HC) and $NO_X$ from construction equipment and vehicles with diesel engine may occur. | | These effects could be mitigated or minimaized by the following countermeasures:<br>• Dust control through water sprinkling at the construction sites and access roads.<br>• Preventive maintenance of construction machineries and vehicles to meet emission standards.<br>• Attentive operation and speed restrictions of construction vehicles and equipment with sufficient effects on mitigation of adverse impacts. |
| | Noise and Vibration | Some noise and vibration may occur during construction due to construction work, transportation and heavy construction equipment. | | • The equipment to be utilised in the construction of the project should be fitted with vibration isolators.<br>• Construction activities should be strictly prohibited at night in the residential areas. (for example, between 8.00PM to 06.00AM)<br>• Near sensitive areas like mosques, schools, hospitals/health centres and important public buildings due care should be taken by adjustments of time to avoid interference with main functions. |
| Water Supply System (Construction of distribution network) | Economic Activity | Traffic congestion and hindrance to pedestrian movement will occur due to the construction works, which will have some temporary impacts on the local economic activities. | Construction Stage | • These impacts will be minor and restricted to the construction stage only.<br>• If required, measures, such as installation of a temporary access passage, will be taken. |
| | Traffic/Public Facilities | During the construction stage, serious disruptions of vehicular traffic and pedestrian, traffic jams, bottlenecks and blockages to roads will be expected.<br>During the construction of house connection, there will be instances where water supply may be disrupted for a certain period of time. | | These effects could be mitigated or minimaized by the following countermeasures:<br>• Announcement and public notification<br>• Arrangement of traffic control staff<br>• Partition of the construction site by a fence<br>• Arrangement of information desk and a person responsible |

| | Environmental Items | Adverse Impact | Stage | Proposed Mitigation Measures |
|---|---|---|---|---|
| Water Supply System (Construction of distribution network) | Public Health Condition | The residents near the construction site may be affected due to increase of noise / vibration, deteriorated air (by vehicles exhaust gas) and dust, etc by using construction vehicles and equipment. | Construction Stage | The effect will be temporary and their duration will not be long as during construction stage.<br>• Dust control through water sprinkling in the construction sites and access roads.<br>• Preventive maintenance of construction equipment and vehicles to meet emission standards will be necessary.<br>• Attentive operation and speed restrictions of construction vehicles and equipment have a sufficient effect on mitigation of adverse impacts. |
| | Solid Waste | Construction of distribution network generates residual soil by excavation. The great portion of solid waste is residual soil without waste material of pipes. | | Leaving the residual soil on a road for a long time expands adverse impacts such as generating of dust and disruptions of vehicular traffic and pedestrian. Therefore, the residual soil should be conveyed immediately to temporary storage site or to disposal site. If possible, using for reclamation or filling is desirable.<br>If possible, as for asphalt waste materials, reproduction as pavement materials is desirable. However, suitable disposal should be performed when reproduction is difficult. |
| | Hazard (Risk) | The accident by the unapproved entry to the construction site can be considered.<br>There is possibility of occurrence of respiratory organs illness of asbestos to workers and residents by work such as cutting of asbestos cement pipe. | | • Countermeasures such as fences and guard man should be arranged.<br>• In principle, the existing distribution line will be abandoned with the present condition. Consequently, the adverse impact at construction sites or move-out processes will be not generated. |
| | Landscape | There is a possibility that the living environment may be affected by construction vehicles, the materials for construction and the temporary facilities. | | The adverse impact will be generated during construction stage, and it is possible that adverse impacts are controlled by the appropriate site management. |

| | Environmental Items | Adverse Impact | Stage | Proposed Mitigation Measures |
|---|---|---|---|---|
| Water Supply System (Construction of distribution network) | Air Pollution | Localized increase in dust due to excavation and earthwork may arise, and temporary increase in the levels of particulate matter (PM), Hydrocarbons (HC), $NO_X$ and others from construction equipment and vehicles with diesel engine may generate. | Construction Stage | Following mitigation measures should be taken for reducing the impacts on air quality:<br>• Equipment and vehicles producing excessive emissions of exhaust gases due to any mechanical fault should not be allowed for operation.<br>• Regular maintenance of vehicles and equipment should be carried out.<br>• Low emission equipment should be used.<br>• Vehicles carrying construction material and residual soil should be covered with tarpaulin or canvas sheet to avoid spilling.<br>• Sprinkling water is effective to control of dust. |
| | Noise and Vibration | Some noise and vibration may arise during construction due to heavy construction equipment. | | These impacts will be limited to the construction period only and can be mitigated by adopting the following measures:<br>• Equipment maintenance should be strengthened to keep them low noise.<br>• Construction activities should be strictly prohibited at night such as between 8:00pm to 06:00am in the residential areas. (Actual time should be determined by the result of the stakeholder meeting.)<br>• Polite operation and speed control are effective in reduction of the adverse impacts.<br>• Especially, near sensitive areas like mosques, schools, hospitals/health centers and important public buildings due care should be taken by adjustments of time to avoid interference with main functions. |
| Sewerage System (TP-1, TP-3) | Solid Waste | Solid waste is generated by exchange of equipments such as a pump and electrical equipment. | Construction Stage | The generated solid waste is recyclable and valuable waste such as pump and iron material. |

| | Environmental Items | Adverse Impact | Stage | Proposed Mitigation Measures |
|---|---|---|---|---|
| Expansion of Reservoir | Water Right / Right of Common | There may be a possibility of adverse impact on the additional water right from the Indus River. | Operation Stage | No additional water intake from Indus river is required till 2025. |
| Water Supply System (Construction of distribution network) | Economic Activity | The household which runs short of water or have not house connection receives water supply by a tanker that is operated by the Ranger. Therefore, if all homes have connection and sufficient water supply can be received, tank-cars water supply will become unnecessary and business will be suspended. There is a possibility of causing unemployment of Rangers. | Operation Stage | The water supply facilities will be constructed step by step till 2025 in the Karachi City, the demand for tank-cars water supply will not decrease immediately. Moreover, it is expected that the rapid increase in population of Karachi city raises the necessity for tank-cars water supply. |
| | Split of Communities | An obvious difference will arise in the water supply service level between adjacent towns and the project area by the implementation of this project. | | Neighbouring towns are also included in the same Master Plan. The opportunity to receive the same water supply service with the project area in the future is obtained. However, project area has a charge system equivalent to water supply service level. |
| | Water Pollution | The increase in the amount of sewage is expected with the increase in the amount of water supply. If appropriate sewage treatment is not performed, the deterioration of water bodies and sanitary environment may arise. | | The priority project is the plan which the water supply system and the sewerage system combined. As for the sewer plan, the increase in sewage is taken into consideration. |

| | Environmental Items | Adverse Impact | Stage | Proposed Mitigation Measures |
|---|---|---|---|---|
| Sewerage System (Rehabilitation of sewage treatment plant (TP-1 & TP-3)) | Split of Communities | The same as water supply system, an obvious difference will arise in the sewage collection service level between neighbouring towns and the project area by the implementation of this project. | Operation Stage | It is the same as the description at the water supply system. |
| | Solid Waste | Sewage treatment plants will generate the considerable sludge in the treatment process. Sludge treatment and disposal may cause environmental contamination, if a proper method is not taken. Moreover, even if it is the appropriate treatment method, there is a case where high cost is needed. | | This project is planning sludge utilization for planting. This method has low adverse impact to the environment, and this is not the high-cost treatment and disposal method. However, monitoring of sludge quality is required in order to confirm safety of sludge utilization for planting. |
| | Water Pollution | The increase in the amount of sewage by improvement in a water supply service level is expected. Moreover, there is possibility of influence in the receiving water bodies of treated sewage. | | If the treatment plants are properly operated and maintained, the effluent will meet the standards and no significant adverse impact may be expected. |
| | Noise and Vibration | The noise and vibration from the sewage treatment plant may influence a surrounding living environment. | | The main generating sounds in these sewage treatment plants (TP-1 and TP-3) are pumps /motors and the sound of the water discharged with a pump.<br>The east and West side of the sewage treatment plant (TP-1) are surrounded by vacant area, and the northern and southern areas of the TP-1 are occupied by many factories.<br>Similarly, the sewage treatment plant (TP-3) is surrounded by factories, container yards and sea area. Therefore, the noise from these sewage treatment plants is not considered to cause the adverse impact to local resident. |

| | Environmental Items | Adverse Impact | Stage | Proposed Mitigation Measures |
|---|---|---|---|---|
| Sewerage System (TP-1 & TP-3) | Offensive Odor | Emission of odour is expected from the sludge and sewage treatment process in the sewage treatment plant. | Operation Stage | Basically, it is expected that when proper operation and maintenance is performed, it is possible to control emission of odour to the minimum. Additionally, it is expected that adverse impact will be reduced by the circumference environment of the sewage treatment plant which is described in the preceding clause.<br>However, the odour monitoring at the boundary of the sewage treatment plant should be carried out. According to the monitoring data, it can be judged whether the circumference environment of the sewage treatment plant met environmental standards. And it is also effective in the data accumulation to the future. |

# Chapter 6 Environmental Management Plan

## 6.1 RISK ANALYSIS AND MITIGATION PLAN

During the operation stage, attention should be paid to the following aspects as Risk Analysis.

**Power supply**

One of the main reasons for malfunction of the water supply facilities and the sewage treatment plants is energy shortage. It is suggested that the power generators and fuel storage against emergency be provided to ensure at least minimum services in case of power cuts.

**Electrical & Mechanical Equipment Failure**

Operational disruption due to electrical & mechanical equipment failures can be avoided by spare parts and stand-by provision available at site. Operation & maintenance instructions and manuals for emergency should be provided with training to the operation staff in the filtration plants and sewage treatment plants.

**Water Pollution and Contamination (Water Supply System)**

Raw water might be possible contaminated. Especially, the contamination by substance which has influence on water use and human health should be considered. If such a situation occurs, measures have to be taken such as raw water bypass and operation stop immediately.

These impacts can be mitigated by adopting the following measures:

- Regular water quality monitoring
- Establishment of urgent communication network with the river administrator and related organization.
- Preparation of the operations manual for emergency situation
- Training to the operation staff for the emergency situation

**Water Pollution and Contamination (Sewerage System)**

The possibility of water quality pollution and contamination of the sewage to the sewage treatment plant by an accidental industrial wastewater can be considered. Accidental water quality problems may cause the following problems:

Malfunction of treatment process

Non compliance with effluent quality standard

Influence on the reuse of treated effluent and sludge

These impacts can be mitigated by adopting the following measures:

- Regular water quality monitoring:
- Factory asset list preparation and its management that possibly emits hazardous wastes.
- Establishment of urgent communication network with listed factories and the Environmental Protection Agency (EPA –Sindh and others.).
- Preparation of the operations manual for emergency situation
- Training to the operation staff for the emergency situation

## 6.2 MONITORING PLAN

The project owner should establish monitoring system to assess the quality of the neighbouring environment after the commissioning of the project. An environmental monitoring programme is important as it provides useful information and helps to:

- Verify the predictions on environmental impacts presented in this study,
- Assist in detecting the development of any unwanted environmental situation, and thus, provides opportunities for adopting appropriate control measures.

**Monitoring plan for Water supply system**

The sampling and water quality analysis of raw water and distributed water will be carried out

to check the performance of treatment plant and safety of water supply service.

**Monitoring plan for Sewerage System**

The sampling and water quality analysis of influent and effluent in the sewage treatment plant will be carried out to check the performance of treatment plant. Moreover, sludge characteristics and air quality should be monitored for the consideration of environmental impacts.

The Preliminary Environmental Monitoring Programmes are summarized in **Table 126.1.20**.

**Table 126.1.20 Preliminary Environmental Monitoring Programme**

| Object | | Monitoring Point | Parameters | Frequency |
|---|---|---|---|---|
| Water Supply System | Water quality (Raw water) | NEK old reservoir | Basic parameters for water supply: Escherichia Coli, Color, Taste, Odor, Turbidity and etc.<br><br>Hazardous substances: According to the WHO Guidelines | - Daily for basic items<br>- Three or four times a year for hazardous substance |
| | Water quality (Distributed water) | | | |
| | Water quality and others (Tap water) | Selected house connections | Water pressure, pH, Turbidity, E. Coli, Total coliform and etc. | - Once in a season for two seasons |
| Sewerage System | Water quality (Influent) | TP-1 and TP-3 | Simple parameters: Temperature, pH, transparency and etc.<br><br>Basic parameters: BOD, $COD_{cr}$, SS, Nitrogen and etc.<br><br>Hazardous substance: According to the effluent Standards. | Daily for the simple parameters and weekly for the basic parameters<br><br>- Three or four times a year for hazardous substances |
| | Water quality (Treated effluent) | | | |
| | Sludge characteristics | | Hazardous substance and etc. | - Twice in a year |
| | Air quality | | Ammonia, Methyl Mercaptan, Hydrogen Sulphide, and etc. | - Three consecutive days in each of two seasons |

# Chapter 7 Public Consultation

The selection of stakeholder is done by KW&SB in collaboration with JICA Study Team, and the stakeholders are categorized as follows.

People in the Study area and people who will be affected by the proposed projects, including socially vulnerable people
Ministries and relevant governmental agencies
Local governments such as municipality, commune, and counsel
International organizations and donors
Non-governmental organizations
Universities and research institutes
Private sector including bulk users

In this Study, three stakeholder meetings (in the early Study stage, the Master Plan stage and the Feasibility stage) were planned in consideration of implementation of EIA Study. The first stakeholder meeting was organized by KW&SB, CDGK, and held on 7 September 2006. The second stakeholder meeting was proposed to be held at the end of the Master Plan stage to inform of contents of the Master Plan and result of environmental and social considerations in the Master

Plan to the stakeholders. However, as the K-IV project and S-3 Project, the former is under PC-1 process and the latter is under pre-qualification stage of consultants, are included in the M/P, KW&SB was reluctant to disclose the information to the public at this stage. Therefore, the stakeholder meeting to inform of the contents of the Master Plan and results of environmental and social considerations was not held. By postponing the 2nd stakeholder meeting, 3rd meeting is not held yet.
The results of the first stakeholder meeting are summarized as below.

**First Stakeholder Meeting**

**(1) Participants**

The stakeholders were selected by KW&SB in collaboration with JICA Study Team and invitation letters were sent to the invitees from 25 August 2006. At this stage, as the contents of M/P are not fixed yet, it is difficult to specify who will be affected directly or indirectly by the project. The main objective is to inform about the approaches to environmental and social considerations, thus, as the representative of the people, Town Nazims (town head) who are elected directly by the people were invited. The following table shows the category and number of participants.

**Table A73.9.1 Number of Attendants at the First Stakeholder Meeting**

| | | | |
|---|---|---|---|
| City District Government | 4 | Universities & Research Institutes | 4 |
| Town Nazims | 7 | NGOs | 3 |
| Government of Sindh | 4 | International Organisations &Donors | 3 |
| Bulk Consumers | 14 | Cantonment Board & DHA | 1 |
| KW&SB | 37 | Media | 7 |
| JICA Study Team | 10 | **TOTAL** | **94** |

**(2) Main Topics Discussed**

The main topics discussed in the meeting are summarized below:

Many Master Plans (M/Ps) were prepared in the late 1980s but never implemented. Various agencies have their own M/Ps so the Study Team should incorporate all the M/Ps into future JICA M/P. Real stakeholders such as towns, citizens should be invited. To this comment, KW&SB answered that the Study Team would go through other M/Ps. About the stakeholders, the representative of Town i.e. Town Nazims are invited to the meeting.

There is the opinion that the treatment plants are not properly working and the nallahs turned into the sewers. To this comment, treatment plants are working but not at full capacity due to the encroachment on the drainage. CDGK will take the action to remove all the encroaching premises to utilize the nallah / drainage for their original use.

There is the suggestion to use another water source such as rain harvesting or groundwater, not only Indus River and Hub Dam. The amount of water necessary for Karachi City is huge and the groundwater is not sufficient for water supply according to the study already carried out. Another source is required and desalination is one option that will be considered.

# Chapter 8 Conclusion

The expected positive impacts of the priority project include:

Realization of the living condition which has possibility to access safe water during all day;

Possibility to collect all of generated sewage and to treat appropriately, and expectation of the health, sanitary and environmental improvement as the result;

Enhanced employment opportunities particularly in the construction stage. Furthermore, promotion of the regional economy by improvement of the living environment of the overall project area is expected.

Based on the findings of the EIA Study, the following items should be considered as mitigation measures for project implementation. However, the following adverse impacts are not fatal. If mitigation measures are taken properly, the adverse impacts will be satisfactorily controlled

extremely.

**Land acquisition for expansion of reservoir (NEK old)**

The site (land owner is the Sindh Province) which adjoins the east side of the existing reservoir is not used for other project and there is sufficient area as the construction site for the expansion of reservoir (NEK Old Reservoir). If this site is determined as a proposed site, it is expected that adverse impacts of land acquisition are very small.

**Construction of water distribution network and sewer collection network**

The main adverse impacts in the construction stage of water distribution network and sewer collection network are effects of the economic activity, traffic situation, public health condition, air pollution, noise and vibration.

Especially, when appropriate measures are not performed, it is expected that serious traffic disturbance will occur. However, these are short-term impacts, and these can be reduced by appropriate construction site management including an announcement and traffic control.

**Impact on the tanker water service by implementation of the Distribution Network Improvement**

The Distribution Network Improvement in the priority project area will be completed by 2014. Consequently, it is predicted that the tanker water service will become unnecessary in the project area and its business will end. However, the water supply facilities in the Karachi city will be constructed step by step till 2025, the demand for tanker water supply will not decrease immediately. In fact, it is even predicted that the quick increase in population of Karachi City will raise the necessity for tanker water service.

**Water pollution and offensive odor from sewage treatment plants (TP-1 and TP-3)**

According to the sewerage system planning, if the treatment plants are properly operated and maintained, the effluent will meet the effluent water quality standards and no significant adverse impacts may be expected. Similarly, it is expected that when proper operation and maintenance is performed, odor emission can be controlled.

**Impact due to disruption of operation of the water supply facilities and the sewage treatment plants (power cut and electrical accident)**

A power failure can be compensated for the installation of power generator. The social infrastructure improvement concerning electricity progresses in the future, and it is expected that power failure will less frequently occur. Furthermore, the adverse Impacts can be controlled to the minimum by preparation of the spare electrical & mechanical equipment, operation manual for emergency, and training to the operation staff for the emergency situation.

# APPENDIX – A127.1

## Economic and Financial Evaluation and Impacts

## A127.1 Economic and Financial Evaluation and Economic Impacts

### Table A127.1.1 Beneficiary and Water Demand of Water Supply Project: 2012 to 2014

| Item | Year | Type 1 | Type 2 | Type 3 | Type 4 | Total |
|---|---|---|---|---|---|---|
| **Beneficiary (Population Base: Unit: 1000)** | | | | | | |
| Existing Residents | | | | | | |
| | 2012 | 170.5 | 199.9 | 100.7 | 136.1 | 607.3 |
| | 2013 | 531.9 | 623.5 | 314.2 | 424.5 | 1,894.0 |
| | 2014 | 716.9 | 840.4 | 423.4 | 572.1 | 2,552.8 |
| | 2015 | 716.9 | 840.4 | 423.4 | 572.1 | 2,552.8 |
| | 2016 | 716.9 | 840.4 | 423.4 | 572.1 | 2,552.8 |
| Increment Residents | | | | | | |
| | 2012 | 11.6 | 13.6 | 6.8 | 9.2 | 41.2 |
| | 2013 | 23.1 | 27.1 | 13.6 | 18.4 | 82.3 |
| | 2014 | 34.7 | 40.6 | 20.5 | 27.7 | 123.4 |
| | 2015 | 34.7 | 40.6 | 20.5 | 27.7 | 123.4 |
| | 2016 | 34.7 | 40.6 | 20.5 | 27.7 | 123.4 |
| Total Residents | | | | | | |
| | 2012 | 182.1 | 213.5 | 107.6 | 145.3 | 648.5 |
| | 2013 | 555.0 | 650.6 | 327.8 | 442.9 | 1,976.3 |
| | 2014 | 751.5 | 881.0 | 443.9 | 599.7 | 2,676.2 |
| | 2015 | 751.5 | 881.0 | 443.9 | 599.7 | 2,676.2 |
| | 2016 | 751.5 | 881.0 | 443.9 | 599.7 | 2,676.2 |
| **Beneficiary (Household Base, Unit:1000)** | | | | | | |
| Existing Residents | | | | | | |
| | 2012 | 24.4 | 28.6 | 14.4 | 19.4 | 86.8 |
| | 2013 | 76.0 | 89.1 | 44.9 | 60.6 | 270.6 |
| | 2014 | 102.4 | 120.1 | 60.5 | 81.7 | 364.7 |
| | 2015 | 102.4 | 120.1 | 60.5 | 81.7 | 364.7 |
| | 2016 | 102.4 | 120.1 | 60.5 | 81.7 | 364.7 |
| Increment Residents | | | | | | |
| | 2012 | 1.7 | 1.9 | 1.0 | 1.3 | 5.9 |
| | 2013 | 3.3 | 3.9 | 1.9 | 2.6 | 11.8 |
| | 2014 | 5.0 | 5.8 | 2.9 | 4.0 | 17.6 |
| | 2015 | 5.0 | 5.8 | 2.9 | 4.0 | 17.6 |
| | 2016 | 5.0 | 5.8 | 2.9 | 4.0 | 17.6 |
| Total Residents | | | | | | |
| | 2012 | 26.0 | 30.5 | 15.4 | 20.8 | 92.6 |
| | 2013 | 79.3 | 92.9 | 46.8 | 63.3 | 282.3 |
| | 2014 | 107.4 | 125.9 | 63.4 | 85.7 | 382.3 |
| | 2015 | 107.4 | 125.9 | 63.4 | 85.7 | 382.3 |
| | 2016 | 107.4 | 125.9 | 63.4 | 85.7 | 382.3 |
| **Domestic Water Consumption of Beneficiaries (Unit: Million $m^3$/Year)** | | | | | | |
| Existing Residents | | | | | | |
| | 2012 | 3.8 | 6.6 | 3.9 | 6.7 | 21.0 |
| | 2013 | 11.8 | 20.8 | 12.2 | 21.2 | 66.0 |
| | 2014 | 16.0 | 28.2 | 16.7 | 29.0 | 90.0 |
| | 2015 | 16.0 | 28.2 | 16.7 | 29.0 | 90.0 |
| | 2016 | 16.0 | 28.2 | 16.7 | 29.0 | 90.0 |
| Increment Residents | | | | | | |
| | 2012 | 0.3 | 0.4 | 0.3 | 0.5 | 1.4 |
| | 2013 | 0.5 | 0.9 | 0.5 | 0.9 | 2.9 |
| | 2014 | 0.8 | 1.4 | 0.8 | 1.4 | 4.4 |
| | 2015 | 0.8 | 1.4 | 0.8 | 1.4 | 4.4 |
| | 2016 | 0.8 | 1.4 | 0.8 | 1.4 | 4.4 |
| Total Residents | | | | | | |
| | 2012 | 4.0 | 7.0 | 4.1 | 7.2 | 22.4 |
| | 2013 | 12.3 | 21.7 | 12.7 | 22.1 | 68.8 |
| | 2014 | 16.8 | 29.6 | 17.5 | 30.4 | 94.4 |
| | 2015 | 16.8 | 29.6 | 17.5 | 30.4 | 94.4 |
| | 2016 | 16.8 | 29.6 | 17.5 | 30.4 | 94.4 |
| **Non-domestic Water Consumption of Beneficiaries (Unit: Million $m^3$/Year)** | | | | | | |
| | 2012 | | | | | 10.5 |
| | 2013 | | | | | 32.3 |
| | 2014 | | | | | 44.0 |
| | 2015 | | | | | 44.0 |
| | 2016 | | | | | 44.0 |

## Table A127.1.2 Economic Benefit of Proposed Water Supply Project

(Unit: Rs. Million)

| Year | Positive Benefit | | | | | |
|---|---|---|---|---|---|---|
| | Domestic Saving Benefit | | | | | Non-domestic Saving Benefit |
| | Type 1 | Type 2 | Type 3 | Type 4 | Sub-total | |
| 2012 | 108 | 215 | 137 | 349 | 809 | 36 |
| 2013 | 439 | 1,323 | 845 | 2,146 | 4,753 | 223 |
| 2014 | 844 | 1,542 | 1,085 | 2,751 | 6,221 | 284 |
| 2015 | 904 | 1,805 | 1,165 | 2,953 | 6,827 | 304 |

| Year | Positive Benefit | | | | | | |
|---|---|---|---|---|---|---|---|
| | Medical Benefit | | | | | | |
| | Family Expense | | | | Medical Treatment | Absence from Work | Sub-total |
| | Type 1 | Type 2 | Type 3 | Type 4 | | | |
| 2012 | 20 | 20 | 12 | 35 | 21 | 2 | 111 |
| 2013 | 42 | 41 | 25 | 72 | 85 | 6 | 272 |
| 2014 | 169 | 165 | 102 | 291 | 150 | 11 | 889 |
| 2015 | 169 | 165 | 102 | 291 | 173 | 13 | 913 |

| Year | Positive Benefit | | Negative Benefit | | |
|---|---|---|---|---|---|
| | Reduction of O&M Expenses | Positive Benefit Total | Distribution Piping | Domestic Water System | |
| | | | | Type 1 | Type 2 |
| 2012 | 11 | 967 | 461 | 363 | 977 |
| 2013 | 45 | 5,292 | 465 | 769 | 2,070 |
| 2014 | 81 | 7,475 | 487 | 394 | 1,060 |
| 2015 | 93 | 8,136 | 0 | 0 | 0 |

| Year | Domestic Water System | | Non-domestic System | Total | Grand Total |
|---|---|---|---|---|---|
| | Type 3 | Type 4 | | | |
| 2012 | 627 | 1729 | 137 | 4293 | -3326 |
| 2013 | 1329 | 3662 | 283 | 8578 | -3285 |
| 2014 | 681 | 1875 | 152 | 4648 | 2827 |
| 2015 | 0 | 0 | 0 | 0 | 8,136 |

## Table A127.1.3 Economic Investment Costs of Water Supply Project

### (1) Water Resource Development

**Financial Value** (Unit: Rs. Billion)

| Year | Direct Cost | | | Engineering | | | Land Acq. | Physical Contingency | | | Price Contingency | | | Administration | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Foreign | Local | Sub-Total | Foreign | Local | Sub-Total | Local | Foreign | Local | Sub-Total | Foreign | Local | Sub-Total | Local | Foreign | Local | Total |
| 2008 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2009 | 0.68 | 0.45 | 1.13 | 0.06 | 0.03 | 0.08 | 0.00 | 0.04 | 0.02 | 0.06 | 0.02 | 0.06 | 0.09 | 0.02 | 0.80 | 0.58 | 1.38 |
| 2010 | 0.68 | 0.45 | 1.13 | 0.06 | 0.03 | 0.08 | 0.00 | 0.04 | 0.02 | 0.06 | 0.04 | 0.10 | 0.13 | 0.02 | 0.81 | 0.62 | 1.43 |
| 2011 | 0.68 | 0.45 | 1.13 | 0.06 | 0.03 | 0.08 | 0.00 | 0.04 | 0.02 | 0.06 | 0.05 | 0.13 | 0.18 | 0.02 | 0.82 | 0.65 | 1.48 |
| Total | 2.03 | 1.35 | 3.39 | 0.18 | 0.08 | 0.25 | 0.00 | 0.11 | 0.07 | 0.18 | 0.11 | 0.29 | 0.40 | 0.06 | 2.43 | 1.85 | 4.28 |

**Economic Value** (Unit: Rs. Billion)

| Year | Direct Cost | | | Engineering | | | Land Acq. | Physical Contingency | | | Price Contingency | | | Administration | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Foreign | Local | Sub-Total | Foreign | Local | Sub-Total | Local | Foreign | Local | Sub-Total | Foreign | Local | Sub-Total | Local | Foreign | Local | Total |
| 2008 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2009 | 0.68 | 0.40 | 1.08 | 0.06 | 0.02 | 0.08 | 0.00 | 0.04 | 0.02 | 0.06 | 0.00 | 0.00 | 0.00 | 0.02 | 0.77 | 0.46 | 1.23 |
| 2010 | 0.68 | 0.40 | 1.08 | 0.06 | 0.02 | 0.08 | 0.00 | 0.04 | 0.02 | 0.06 | 0.00 | 0.00 | 0.00 | 0.02 | 0.77 | 0.46 | 1.23 |
| 2011 | 0.68 | 0.40 | 1.08 | 0.06 | 0.02 | 0.08 | 0.00 | 0.04 | 0.02 | 0.06 | 0.00 | 0.00 | 0.00 | 0.02 | 0.77 | 0.46 | 1.23 |
| Total | 2.03 | 1.19 | 3.23 | 0.18 | 0.07 | 0.25 | 0.00 | 0.11 | 0.06 | 0.17 | 0.00 | 0.00 | 0.00 | 0.06 | 2.32 | 1.38 | 3.70 |

### (2) Distribution Network Improvement

**Financial Value** (Unit: Rs. Billion)

| Year | Direct Cost | | | Engineering | | | Land Acq. | Physical Contingency | | | Price Contingency | | | Administration | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Foreign | Local | Sub-Total | Foreign | Local | Sub-Total | Local | Foreign | Local | Sub-Total | Foreign | Local | Sub-Total | Local | Foreign | Local | Total |
| 2012 | 1.51 | 0.60 | 2.12 | 0.19 | 0.08 | 0.28 | 0.00 | 0.09 | 0.03 | 0.12 | 0.14 | 0.25 | 0.38 | 0.04 | 1.93 | 1.01 | 2.94 |
| 2013 | 3.10 | 1.23 | 4.34 | 0.19 | 0.08 | 0.28 | 0.00 | 0.16 | 0.07 | 0.23 | 0.32 | 0.58 | 0.90 | 0.09 | 3.78 | 2.05 | 5.83 |
| 2014 | 1.59 | 0.63 | 2.22 | 0.10 | 0.04 | 0.14 | 0.00 | 0.08 | 0.03 | 0.12 | 0.19 | 0.35 | 0.55 | 0.05 | 1.96 | 1.10 | 3.07 |
| Total | 6.21 | 2.47 | 8.68 | 0.48 | 0.21 | 0.69 | 0.00 | 0.33 | 0.13 | 0.47 | 0.66 | 1.18 | 1.83 | 0.18 | 7.68 | 4.16 | 11.84 |

**Economic Value** (Unit: Rs. Billion)

| Year | Direct Cost | | | Engineering | | | Land Acq. | Physical Contingency | | | Price Contingency | | | Administration | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Foreign | Local | Sub-Total | Foreign | Local | Sub-Total | Local | Foreign | Local | Sub-Total | Foreign | Local | Sub-Total | Local | Foreign | Local | Total |
| 2012 | 1.51 | 0.53 | 2.05 | 0.19 | 0.07 | 0.27 | 0.00 | 0.09 | 0.03 | 0.12 | 0.00 | 0.00 | 0.00 | 0.04 | 1.79 | 0.67 | 2.47 |
| 2013 | 3.10 | 1.09 | 4.19 | 0.19 | 0.07 | 0.27 | 0.00 | 0.16 | 0.06 | 0.22 | 0.00 | 0.00 | 0.00 | 0.08 | 3.46 | 1.29 | 4.75 |
| 2014 | 1.59 | 0.55 | 2.14 | 0.10 | 0.04 | 0.13 | 0.00 | 0.08 | 0.03 | 0.11 | 0.00 | 0.00 | 0.00 | 0.04 | 1.77 | 0.66 | 2.43 |
| Total | 6.21 | 2.17 | 8.38 | 0.48 | 0.18 | 0.66 | 0.00 | 0.33 | 0.12 | 0.45 | 0.00 | 0.00 | 0.00 | 0.15 | 7.02 | 2.63 | 9.65 |

## Table A127.1.4 Economic O&M Costs of Water Supply Project

**Bulk Water Source**

**Financial Value** (Unit: Rs. Million)

| Year | Elec-tricity | Chemi-cal | Mainte-nance | Other Costs | Price Contin-gency | Total |
|---|---|---|---|---|---|---|
| 2012 | 26 | 0 | 10 | 44 | 20 | 101 |
| 2013 | 78 | 0 | 31 | 49 | 41 | 199 |
| 2014 | 104 | 0 | 42 | 52 | 59 | 257 |
| 2015 | 104 | 0 | 42 | 52 | 70 | 267 |
| 2016 | 104 | 0 | 42 | 52 | 81 | 278 |
| 2017 | 104 | 0 | 42 | 52 | 92 | 290 |
| 2018 | 104 | 0 | 42 | 52 | 104 | 302 |
| 2019 | 104 | 0 | 42 | 52 | 117 | 314 |
| 2020 | 104 | 0 | 42 | 52 | 130 | 328 |
| 2021 | 104 | 0 | 42 | 52 | 144 | 342 |
| 2022 | 104 | 0 | 42 | 52 | 159 | 357 |
| 2023 | 104 | 0 | 42 | 52 | 175 | 372 |
| 2024 | 104 | 0 | 42 | 52 | 191 | 389 |
| 2025 | 104 | 0 | 42 | 52 | 209 | 406 |
| 2026 | 104 | 0 | 42 | 52 | 227 | 425 |
| :: | :: | :: | :: | :: | :: | :: |
| :: | :: | :: | :: | :: | :: | :: |
| 2044 | 104 | 0 | 42 | 52 | 806 | 1,003 |

**Economic Value** (Unit: Rs. Million)

| Year | Elec-tricity | Chemi-cal | Mainte-nance | Other Costs | Price Contin-gency | Total |
|---|---|---|---|---|---|---|
| 2012 | 25 | 0 | 10 | 39 | 0 | 74 |
| 2013 | 75 | 0 | 30 | 43 | 0 | 148 |
| 2014 | 100 | 0 | 40 | 46 | 0 | 186 |
| 2015 | 100 | 0 | 40 | 46 | 0 | 186 |
| 2016 | 100 | 0 | 40 | 46 | 0 | 186 |
| 2017 | 100 | 0 | 40 | 46 | 0 | 186 |
| 2018 | 100 | 0 | 40 | 46 | 0 | 186 |
| 2019 | 100 | 0 | 40 | 46 | 0 | 186 |
| 2020 | 100 | 0 | 40 | 46 | 0 | 186 |
| 2021 | 100 | 0 | 40 | 46 | 0 | 186 |
| 2022 | 100 | 0 | 40 | 46 | 0 | 186 |
| 2023 | 100 | 0 | 40 | 46 | 0 | 186 |
| 2024 | 100 | 0 | 40 | 46 | 0 | 186 |
| 2025 | 100 | 0 | 40 | 46 | 0 | 186 |
| 2026 | 100 | 0 | 40 | 46 | 0 | 186 |
| :: | :: | :: | :: | :: | :: | :: |
| :: | :: | :: | :: | :: | :: | :: |
| 2055 | 100 | 0 | 40 | 46 | 0 | 186 |

**DNI (Including O&M and Replacement Costs)**

**Financial Value** (Unit: Rs. Million)

| Year | Elec-tricity | Chemi-cal | Mainte-nance | Other Costs | Price Contin-gency | Total |
|---|---|---|---|---|---|---|
| 2012 | 0 | 0 | 55 | 0 | 9 | 64 |
| 2013 | 0 | 0 | 165 | 0 | 32 | 197 |
| 2014 | 0 | 0 | 220 | 0 | 50 | 271 |
| 2015 | 0 | 0 | 220 | 0 | 59 | 279 |
| 2016 | 0 | 0 | 220 | 0 | 68 | 288 |
| 2017 | 0 | 0 | 220 | 0 | 77 | 297 |
| 2018 | 0 | 0 | 220 | 0 | 87 | 307 |
| 2019 | 0 | 0 | 220 | 0 | 97 | 317 |
| 2020 | 0 | 0 | 220 | 0 | 108 | 328 |
| 2021 | 0 | 0 | 220 | 0 | 119 | 339 |
| 2022 | 0 | 0 | 220 | 0 | 131 | 351 |
| 2023 | 0 | 0 | 220 | 0 | 143 | 364 |
| 2024 | 0 | 0 | 220 | 0 | 156 | 377 |
| 2025 | 0 | 0 | 220 | 0 | 170 | 390 |
| 2026 | 0 | 0 | 220 | 0 | 0 | 221 |
| :: | :: | :: | :: | :: | :: | :: |
| :: | :: | :: | :: | :: | :: | :: |
| 2044 | 0 | 0 | 220 | 0 | 618 | 839 |

**Economic Value** (Unit: Rs. Million)

| Year | Elec-tricity | Chemi-cal | Mainte-nance | Other Costs | Price Contin-gency | Total |
|---|---|---|---|---|---|---|
| 2012 | 0 | 0 | 53 | 0 | 0 | 53 |
| 2013 | 0 | 0 | 159 | 0 | 0 | 159 |
| 2014 | 0 | 0 | 212 | 0 | 0 | 212 |
| 2015 | 0 | 0 | 212 | 0 | 0 | 212 |
| 2016 | 0 | 0 | 212 | 0 | 0 | 212 |
| 2017 | 0 | 0 | 212 | 0 | 0 | 212 |
| 2018 | 0 | 0 | 212 | 0 | 0 | 212 |
| 2019 | 0 | 0 | 212 | 0 | 0 | 212 |
| 2020 | 0 | 0 | 212 | 0 | 0 | 212 |
| 2021 | 0 | 0 | 212 | 0 | 0 | 212 |
| 2022 | 0 | 0 | 212 | 0 | 0 | 212 |
| 2023 | 0 | 0 | 212 | 0 | 0 | 212 |
| 2024 | 0 | 0 | 212 | 0 | 0 | 212 |
| 2025 | 0 | 0 | 212 | 0 | 0 | 212 |
| 2026 | 0 | 0 | 212 | 0 | 0 | 212 |
| :: | :: | :: | :: | :: | :: | :: |
| :: | :: | :: | :: | :: | :: | :: |
| 2055 | 0 | 0 | 212 | 0 | 0 | 212 |

## Table A127.1.5 Economic Replacement Costs of Water Supply Project

**Bulk Water Source**

**Financial Value** (Unit: Rs. Million)

| Year | Direct Cost | Other Costs | Price Contin-gency | Total |
|---|---|---|---|---|
| 2023 | 0 | 0 | 0 | 0 |
| 2024 | 535 | 120 | 170 | 825 |
| 2025 | 535 | 120 | 182 | 836 |
| 2026 | 535 | 120 | 193 | 848 |
| 2027 | 0 | 0 | 0 | 0 |
| :: | :: | :: | :: | :: |
| :: | :: | :: | :: | :: |
| :: | :: | :: | :: | :: |
| 2035 | 0 | 0 | 0 | 0 |
| 2036 | 0 | 0 | 0 | 0 |
| 2037 | 0 | 0 | 0 | 0 |
| 2038 | 0 | 0 | 0 | 0 |
| 2039 | 535 | 83 | 368 | 986 |
| 2040 | 535 | 84 | 383 | 1,001 |
| 2041 | 535 | 84 | 389 | 1,008 |
| 2042 | 0 | 0 | 0 | 0 |
| 2043 | 0 | 0 | 0 | 0 |
| 2044 | 0 | 0 | 0 | 0 |

**Economic Value** (Unit: Rs. Million)

| Year | Direct Cost | Other Costs | Price Contin-gency | Total |
|---|---|---|---|---|
| 2023 | 0 | 0 | 0 | 0 |
| 2024 | 535 | 64 | 0 | 599 |
| 2025 | 535 | 64 | 0 | 599 |
| 2026 | 535 | 64 | 0 | 599 |
| 2027 | 0 | 0 | 0 | 0 |
| :: | :: | :: | :: | :: |
| :: | :: | :: | :: | :: |
| :: | :: | :: | :: | :: |
| 2035 | 0 | 0 | 0 | 0 |
| 2036 | 0 | 0 | 0 | 0 |
| 2037 | 0 | 0 | 0 | 0 |
| 2038 | 0 | 0 | 0 | 0 |
| 2039 | 535 | 75 | 0 | 610 |
| 2040 | 535 | 75 | 0 | 610 |
| 2041 | 535 | 75 | 0 | 610 |
| 2042 | 0 | 0 | 0 | 0 |
| 2043 | 0 | 0 | 0 | 0 |
| 2044 | 0 | 0 | 0 | 0 |

## Table A127.1.6 Economic Cost and Benefit Stream and Evaluation Indices of Water Supply Project

| No. | Year | Cost | | | | | | Benefit | | | | | | Balance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Bulk Water Source*1 | | | DNI | | Total | Domestic Saving | Medical Benefit | Non-domestic Saving | Saving Costs of Existing O&M | Negative Benefit | Total | |
| | | Plants | O&M *2 | Replace-ment | Capital Invest | O&M + Replace-ment | | | | | | | | |
| 1 | 2009 | 1,233 | 0 | | | | 1,233 | 0 | 0 | 0 | 0 | 0 | 0 | -1,233 |
| 2 | 2010 | 1,233 | 0 | | | | 1,233 | 0 | 0 | 0 | 0 | 0 | 0 | -1,233 |
| 3 | 2011 | 1,234 | 0 | | | | 1,234 | 0 | 0 | 0 | 0 | 0 | 0 | -1,234 |
| 4 | 2012 | 1,207 | 74 | | 4,276 | 53 | 5,609 | 809 | 111 | 36 | 11 | 4,293 | -3,326 | -8,935 |
| 5 | 2013 | | 148 | | 4,754 | 159 | 5,061 | 4,753 | 272 | 223 | 45 | 8,578 | -3,285 | -8,346 |
| 6 | 2014 | | 186 | | 2,429 | 212 | 2,828 | 6,221 | 889 | 284 | 81 | 4,648 | 2,827 | -1 |
| 7 | 2015 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 8 | 2016 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 9 | 2017 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 10 | 2018 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 11 | 2019 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 12 | 2020 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 13 | 2021 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 14 | 2022 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 15 | 2023 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 16 | 2024 | | 186 | 610 | | 212 | 1,008 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,128 |
| 17 | 2025 | | 186 | 610 | | 212 | 1,008 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,128 |
| 18 | 2026 | | 186 | 610 | | 212 | 1,008 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,128 |
| 19 | 2027 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 20 | 2028 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 21 | 2029 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 22 | 2030 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 23 | 2031 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 24 | 2032 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 25 | 2033 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 26 | 2034 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 27 | 2035 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 28 | 2036 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 29 | 2037 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 30 | 2038 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 31 | 2039 | | 186 | 610 | | 212 | 1,008 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,128 |
| 32 | 2040 | | 186 | 610 | | 212 | 1,008 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,128 |
| 33 | 2041 | | 186 | 610 | | 212 | 1,008 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,128 |
| 34 | 2042 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 35 | 2043 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |
| 36 | 2044 | | 186 | | | 212 | 398 | 6,827 | 913 | 304 | 93 | 0 | 8,136 | 7,738 |

Remark: *1 Water source costs for the Priority Project were estimated as a part of the bulk water suupy system, which were calculated as a proportional amount of total zone west water demand to the total water demand in Karachi City in 2016.

*2 In 2012, the existing water source facilities as of 2012 are involved into the project.

*3 Replacement cost of new pipes is included in O&M cost.

**EIRR: 23.5%** **NPV: 17.9 Billion Rupees** **B/C: 2.40**

## Table A127.1.7 Sensitivity Test of Economic Evaluation of Water Supply Project

EIRR

| | | Cost | | |
|---|---|---|---|---|
| | | 0% | +10% | +20% |
| Benefit | 0% | 23.5 | 22.1 | 20.9 |
| | -10% | 22.0 | 20.7 | 19.5 |
| | -20% | 20.4 | 19.0 | 17.9 |

NPV (Rs. Million)

| | | Cost | | |
|---|---|---|---|---|
| | | 0% | +10% | +20% |
| Benefit | 0% | 17,885 | 16,216 | 15,330 |
| | -10% | 14,819 | 13,541 | 12,264 |
| | -20% | 11,753 | 10,475 | 9,198 |

B/C

| | | Cost | | |
|---|---|---|---|---|
| | | 0% | +10% | +20% |
| Benefit | 0% | 2.40 | 2.18 | 2.00 |
| | -10% | 2.16 | 1.96 | 1.80 |
| | -20% | 1.92 | 1.75 | 1.60 |

## Table A127.1.8 Beneficiary and Sewerage Discharge: 2014 to 2016

| Year | TP1 & TP3 | Beneficiaries by Type (Income Level) | | | | |
|---|---|---|---|---|---|---|
| | | Type 1 | Type 2 | Type 3 | Type 4 | Total |
| **Beneficiary (Population Base: Unit: 1000)** | | | | | | |
| 2012 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2013 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2014 | 2,417 | 679 | 796 | 401 | 542 | 2,417 |
| 2015 | 2,417 | 679 | 796 | 401 | 542 | 2,417 |
| 2016 | 2,417 | 679 | 796 | 401 | 542 | 2,417 |
| **Beneficiary (Household Base, Unit:1000)** | | | | | | |
| 2012 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2013 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2014 | 345 | 97 | 114 | 57 | 77 | 345 |
| 2015 | 345 | 97 | 114 | 57 | 77 | 345 |
| 2016 | 345 | 97 | 114 | 57 | 77 | 345 |

**Sewage Discharge Volume by TP & Domestic/Non-domestic (Unit: $10^6$ $m^3$/Year)**

| | | Total | Domestic | Non-domestic |
|---|---|---|---|---|
| 2012 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2013 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2014 | 35.3 | 35.3 | 24.1 | 11.2 |
| 2015 | 70.7 | 70.7 | 48.2 | 22.5 |
| 2016 | 70.7 | 70.7 | 48.2 | 22.5 |

**Sewage Treated Volume by Generator (Unit: 106 m3/Year)**

| | Total | Beneficiaries by Type (Income Level) | | | | Non- |
|---|---|---|---|---|---|---|
| | | Type 1 | Type 2 | Type 3 | Type 4 | domestic |
| 2012 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2013 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2014 | 35.3 | 4.3 | 7.6 | 4.5 | 7.8 | 11.2 |
| 2015 | 70.7 | 8.6 | 15.1 | 9.0 | 15.6 | 22.5 |
| 2016 | 70.7 | 8.6 | 15.1 | 9.0 | 15.6 | 22.5 |

## Table A127.1.9 Economic Benefit of Sewerage Project

(Unit: Rs. Million)

| Year | Domestic Benefit of Improved Environment | | | | | Non-domestic Benefit of Imp. |
|---|---|---|---|---|---|---|
| | Type 1 | Type 2 | Type 3 | Type 4 | Sub-total | |
| 2012 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2013 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2014 | 24.94 | 75.82 | 61.60 | 174.60 | 336.95 | 85.79 |
| 2015 | 49.87 | 151.64 | 123.19 | 349.20 | 673.91 | 171.58 |

| Year | Medical Benefit | | | | | | |
|---|---|---|---|---|---|---|---|
| | Family Expense | | | | Medical Treatment | Absence from Work | Sub-total |
| | Type 1 | Type 2 | Type 3 | Type 4 | | | |
| 2012 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2013 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2014 | 30.51 | 29.89 | 18.51 | 52.54 | 28.09 | 1.81 | 161.34 |
| 2015 | 61.02 | 59.77 | 37.01 | 105.08 | 56.19 | 3.61 | 322.68 |

| Year | Saving Benefit of O&M Expenses of Septic Tank | | | Reduction of O&M Expenses | Positive Benefit Total |
|---|---|---|---|---|---|
| | Type 1 | Type 2 | Total | | |
| 2012 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2013 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2014 | 7.29 | 16.72 | 24.02 | 7.23 | 615.33 |
| 2015 | 14.59 | 33.45 | 48.04 | 29.56 | 1,245.76 |

| Year | Negative Benefit | | | | Grand Total |
|---|---|---|---|---|---|
| | Disposal of Existing Sewer | Elimination of Septic Tanks | | | |
| | | Type 1 | Type 2 | Total | |
| 2012 | 15.11 | 0.00 | 0.00 | 15.11 | -15.11 |
| 2013 | 13.27 | 0.00 | 0.00 | 13.27 | -13.27 |
| 2014 | 13.32 | 37.32 | 85.55 | 136.19 | 479.14 |
| 2015 | 0 | 0.00 | 0.00 | 0.00 | 1,245.76 |

## Table A127.1.10 Investment Costs of Sewerage Project

**Financial Value** (Unit: Rs. Million)

| Year | Direct Cost | | | Engineering | | | Physical Contingency | | |
|---|---|---|---|---|---|---|---|---|---|
| | Foreign | Local | Sub-Total | Foreign | Local | Sub-Total | Foreign | Local | Sub-Total |
| 2012 | 191.68 | 505.84 | 697.52 | 55.64 | 23.85 | 79.49 | 12.37 | 26.48 | 38.85 |
| 2013 | 356.68 | 910.43 | 1,267.10 | 55.64 | 23.85 | 79.49 | 20.62 | 46.71 | 67.33 |
| 2014 | 164.98 | 404.56 | 569.54 | 27.82 | 11.92 | 39.74 | 9.64 | 20.82 | 30.46 |
| Total | 713.33 | 1,820.83 | 2,534.16 | 139.11 | 59.62 | 198.72 | 42.62 | 94.02 | 136.64 |

| Year | Price Contingency | | | Administration | Total | | |
|---|---|---|---|---|---|---|---|
| | Foreign | Local | Sub-Total | Local | Foreign | Local | Total |
| 2012 | 20.07 | 188.11 | 208.18 | 15.36 | 279.75 | 759.64 | 1,039.40 |
| 2013 | 40.45 | 410.56 | 451.02 | 27.97 | 473.39 | 1,419.52 | 1,892.91 |
| 2014 | 22.24 | 220.24 | 242.48 | 13.23 | 224.67 | 670.79 | 895.46 |
| Total | 82.76 | 818.92 | 901.68 | 56.57 | 977.81 | 2,849.95 | 3,827.77 |

**Economic Value** (Unit: Rs. Billion)

| Year | Direct Cost | | | Engineering | | | Physical Contingency | | |
|---|---|---|---|---|---|---|---|---|---|
| | Foreign | Local | Sub-Total | Foreign | Local | Sub-Total | Foreign | Local | Sub-Total |
| 2012 | 191.68 | 445.14 | 636.82 | 55.64 | 20.98 | 76.63 | 12.37 | 23.31 | 35.67 |
| 2013 | 356.68 | 801.18 | 1,157.85 | 55.64 | 20.98 | 76.63 | 20.62 | 41.11 | 61.72 |
| 2014 | 164.98 | 356.02 | 520.99 | 27.82 | 10.49 | 38.31 | 9.64 | 18.33 | 27.97 |
| Total | 713.33 | 1,602.33 | 2,315.66 | 139.11 | 52.46 | 191.57 | 42.62 | 82.74 | 125.36 |

| Year | Price Contingency | | | Administration | Grand Total | | |
|---|---|---|---|---|---|---|---|
| | Foreign | Local | Sub-Total | Local | Foreign | Local | Total |
| 2012 | 0.00 | 0.00 | 0.00 | 11.24 | 259.68 | 500.67 | 760.35 |
| 2013 | 0.00 | 0.00 | 0.00 | 19.44 | 432.93 | 882.71 | 1,315.64 |
| 2014 | 0.00 | 0.00 | 0.00 | 8.81 | 202.44 | 393.64 | 596.08 |
| Total | 0.00 | 0.00 | 0.00 | 39.49 | 895.05 | 1,777.02 | 2,672.07 |

Remark: The table indicates facilities newly constructed in the project.

## Table A127.1.11 Economic O&M Costs of Sewerage Project

**Financial Value** (Unit: Rs. Million)

| Year | Elec-tricity | Sludge Dispo-sal | Mainte-nance | Person-nel | Other Costs | Price Contin-gency | Total |
|---|---|---|---|---|---|---|---|
| 2012 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2013 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2014 | 11.62 | 2.45 | 6.00 | 5.65 | 5.29 | 8.92 | 39.94 |
| 2015 | 23.25 | 4.90 | 12.01 | 11.30 | 10.59 | 20.93 | 82.98 |
| 2016 | 23.25 | 4.90 | 12.01 | 11.30 | 10.59 | 24.18 | 86.23 |
| 2017 | 23.25 | 4.90 | 12.01 | 11.30 | 10.59 | 27.60 | 89.65 |
| 2018 | 23.25 | 4.90 | 12.01 | 11.30 | 10.59 | 31.20 | 93.25 |
| 2019 | 23.25 | 4.90 | 12.01 | 11.30 | 10.59 | 34.99 | 97.04 |
| 2020 | 23.25 | 4.90 | 12.01 | 11.30 | 10.59 | 38.98 | 101.03 |
| 2021 | 23.25 | 4.90 | 12.01 | 11.30 | 10.59 | 43.18 | 105.23 |
| 2022 | 23.25 | 4.90 | 12.01 | 11.30 | 10.59 | 47.61 | 109.66 |
| 2023 | 23.25 | 4.90 | 12.01 | 11.30 | 10.59 | 52.27 | 114.32 |
| 2024 | 23.25 | 4.90 | 12.01 | 11.30 | 10.59 | 57.19 | 119.23 |
| 2025 | 23.25 | 4.90 | 12.01 | 11.30 | 10.59 | 62.36 | 124.41 |
| 2026 | 23.25 | 4.90 | 12.01 | 0.01 | 10.59 | 67.83 | 118.58 |
| :: | :: | :: | :: | | :: | :: | :: |
| :: | :: | :: | :: | | :: | :: | :: |
| 2044 | 23.25 | 4.90 | 12.01 | 0.01 | 10.59 | 0.37 | 51.13 |

**Economic Value** (Unit: Rs. Million)

| Year | Elec-tricity | Sludge Dispo-sal | Mainte-nance | Person-nel | Other Costs | Price Contin-gency | Total |
|---|---|---|---|---|---|---|---|
| 2012 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2013 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2014 | 11.20 | 0.00 | 5.79 | 4.97 | 3.90 | 0.00 | 25.87 |
| 2015 | 22.41 | 0.00 | 11.57 | 9.95 | 7.81 | 0.00 | 51.74 |
| 2016 | 22.41 | 0.00 | 11.57 | 9.95 | 7.81 | 0.00 | 51.74 |
| 2017 | 22.41 | 0.00 | 11.57 | 9.95 | 7.81 | 0.00 | 51.74 |
| 2018 | 22.41 | 0.00 | 11.57 | 9.95 | 7.81 | 0.00 | 51.74 |
| 2019 | 22.41 | 0.00 | 11.57 | 9.95 | 7.81 | 0.00 | 51.74 |
| 2020 | 22.41 | 0.00 | 11.57 | 9.95 | 7.81 | 0.00 | 51.74 |
| 2021 | 22.41 | 0.00 | 11.57 | 9.95 | 7.81 | 0.00 | 51.74 |
| 2022 | 22.41 | 0.00 | 11.57 | 9.95 | 7.81 | 0.00 | 51.74 |
| 2023 | 22.41 | 0.00 | 11.57 | 9.95 | 7.81 | 0.00 | 51.74 |
| 2024 | 22.41 | 0.00 | 11.57 | 9.95 | 7.81 | 0.00 | 51.74 |
| 2025 | 22.41 | 0.00 | 11.57 | 9.95 | 7.81 | 0.00 | 51.74 |
| 2026 | 22.41 | 0.00 | 11.57 | 9.95 | 7.81 | 0.00 | 51.74 |
| :: | :: | :: | :: | | :: | :: | :: |
| :: | :: | :: | :: | | :: | :: | :: |
| 2055 | 22.41 | 0.00 | 11.57 | 9.95 | 7.81 | 0.00 | 51.74 |

## Table A127.1.12 Economic Replacement Costs of Sewerage Project

**Financial Value** (Unit: Rs. Million)

| Year | Direct Cost | Engi-neering Cost | Physical Contin-gency | Admin-istration | Price Contin-gency | Total |
|---|---|---|---|---|---|---|
| 2026 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2027 | 91.03 | 10.83 | 5.09 | 1.85 | 16.52 | 125.32 |
| 2028 | 180.50 | 10.83 | 9.57 | 3.59 | 38.17 | 242.66 |
| 2029 | 89.44 | 5.41 | 4.74 | 1.83 | 22.65 | 124.08 |
| 2030 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2031 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2032 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2033 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2034 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2035 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| :: | :: | | | :: | :: | :: |
| :: | :: | | | :: | :: | :: |
| 2041 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2042 | 91.03 | 10.83 | 5.09 | 5.55 | 262.97 | 375.47 |
| 2043 | 180.50 | 10.83 | 9.57 | 5.74 | 181.68 | 388.32 |
| 2044 | 89.44 | 5.41 | 4.74 | 2.91 | 94.16 | 196.67 |

**Economic Value** (Unit: Rs. Million)

| Year | Direct Cost | Engi-neering Cost | Physical Contin-gency | Admin-istration | Price Contin-gency | Total |
|---|---|---|---|---|---|---|
| 2026 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2027 | 91.03 | 10.44 | 4.91 | 1.60 | 0.00 | 107.97 |
| 2028 | 180.50 | 10.44 | 9.23 | 3.00 | 0.00 | 203.17 |
| 2029 | 89.44 | 5.22 | 4.57 | 1.49 | 0.00 | 100.72 |
| 2030 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2031 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2032 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2033 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2034 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2035 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| :: | :: | | | :: | :: | :: |
| :: | :: | | | :: | :: | :: |
| 2041 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2042 | 91.03 | 10.44 | 4.91 | 1.60 | 0.00 | 107.97 |
| 2043 | 180.50 | 10.44 | 9.23 | 3.00 | 0.00 | 203.17 |
| 2044 | 89.44 | 5.22 | 4.57 | 1.49 | 0.00 | 100.72 |

## Table A127.1.13 Economic Cost and Benefit Stream and Evaluation Indices of Sewerage Project

(Unit: Rs. Million)

| No. | Year | Cost | | | | Benefit | | | | | | | Balance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Saving of O&M Cost | | | | |
| | | Capital Invest-ment | O&M | Replace-ment | Total | Domestic Benefit | Medical Benefit | Non-domestic Benefit | Septic Tank | Existing Sewerage System | Nega-tive Benefit | Total | |
| 1 | 2008 | 612 | 0 | | 612 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -612 |
| 2 | 2009 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 2010 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 2011 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 2012 | 1,533 | 0 | | 1,533 | 0 | 0 | 0 | 0 | 0 | 15 | -15 | -1,548 |
| 6 | 2013 | 1,316 | 0 | | 1,316 | 0 | 0 | 0 | 0 | 0 | 13 | -13 | -1,329 |
| 7 | 2014 | 598 | 26 | | 624 | 337 | 161 | 86 | 24 | 7 | 136 | 479 | -145 |
| 8 | 2015 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 9 | 2016 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 10 | 2017 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 11 | 2018 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 12 | 2019 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 13 | 2020 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 14 | 2021 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 15 | 2022 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 16 | 2023 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 17 | 2024 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 18 | 2025 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 19 | 2026 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 20 | 2027 | | 52 | 108 | 160 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,086 |
| 21 | 2028 | | 52 | 203 | 255 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 991 |
| 22 | 2029 | | 52 | 101 | 152 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,093 |
| 23 | 2030 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 24 | 2031 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 25 | 2032 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 26 | 2033 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 27 | 2034 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 28 | 2035 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 29 | 2036 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 30 | 2037 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 31 | 2038 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 32 | 2039 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 33 | 2040 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 34 | 2041 | | 52 | | 52 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,194 |
| 35 | 2042 | | 52 | 108 | 160 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,086 |
| 36 | 2043 | | 52 | 203 | 255 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 991 |
| 37 | 2044 | | 52 | 101 | 152 | 674 | 323 | 172 | 48 | 30 | 0 | 1,246 | 1,093 |

Remark: The existing fixed assets of sewerage systems were carried over into the priority project.
TP3 system accounts for 41.8% of the total sunk cost (Rs.1.46 billion) in 2008.
TP1 system accounts of the total sunk cost (Rs.0.77 billion) in 2014.

**EIRR: 20.3%** **NPV: 2,142 Million Rupees** **B/C: 1.82**

## Table A127.1.14 Sensitivity Test of Economic Evaluation of Sewerage Project

**EIRR**

| | | Cost | | |
|---|---|---|---|---|
| | | 0% | +10% | +20% |
| Benefit | 0% | 20.3 | 18.8 | 17.5 |
| | -10% | 18.7 | 17.3 | 16.1 |
| | -20% | 17.0 | 15.6 | 14.5 |

**NPV (Rs. Million)**

| | | Cost | | |
|---|---|---|---|---|
| | | 0% | +10% | +20% |
| Benefit | 0% | 5,193 | 4,868 | 4,543 |
| | -10% | 4,349 | 4,023 | 3,698 |
| | -20% | 3,504 | 3,179 | 2,854 |

**B/C**

| | | Cost | | |
|---|---|---|---|---|
| | | 0% | +10% | +20% |
| Benefit | 0% | 2.60 | 2.36 | 2.16 |
| | -10% | 2.34 | 2.13 | 1.95 |
| | -20% | 2.03 | 1.89 | 1.73 |

## Table A127.1.15 Economic Cost and Benefit Stream and Evaluation Indices of Integrated Project

(Unit: Rs. Million)

| No. | Year | Cost | | | | Benefit | | | | Balance |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Water Supply | | Sewerage System | Total | Water Supply Benefits | Sewerage Benefits | Negative Benefits | Total | |
| | | Water Source | DNI System | | | | | | | |
| 1 | 2008 | 0 | 0 | 612 | 612 | 0 | 0 | 0 | 0 | -612 |
| 2 | 2009 | 1,233 | 0 | 0 | 1,233 | 0 | 0 | 0 | 0 | -1,233 |
| 3 | 2010 | 1,233 | 0 | 0 | 1,233 | 0 | 0 | 0 | 0 | -1,233 |
| 4 | 2011 | 1,234 | 0 | 0 | 1,234 | 0 | 0 | 0 | 0 | -1,234 |
| 5 | 2012 | 1,280 | 4,329 | 1,533 | 7,142 | 967 | 0 | 4,308 | -3,341 | -10,483 |
| 6 | 2013 | 148 | 4,913 | 1,316 | 6,377 | 5,292 | 0 | 8,591 | -3,299 | -9,675 |
| 7 | 2014 | 186 | 2,642 | 624 | 3,452 | 7,475 | 615 | 4,784 | 3,306 | -146 |
| 8 | 2015 | 186 | 212 | 52 | 450 | 8,136 | 1,246 | 0 | 9,382 | 8,932 |
| 9 | 2016 | 186 | 212 | 52 | 450 | 8,136 | 1,246 | 0 | 9,382 | 8,932 |
| 10 | 2017 | 186 | 212 | 52 | 450 | 8,136 | 1,246 | 0 | 9,382 | 8,932 |
| 11 | 2018 | 186 | 212 | 52 | 450 | 8,136 | 1,246 | 0 | 9,382 | 8,932 |
| 12 | 2019 | 186 | 212 | 52 | 450 | 8,136 | 1,246 | 0 | 9,382 | 8,932 |
| 13 | 2020 | 186 | 212 | 52 | 450 | 8,136 | 1,246 | 0 | 9,382 | 8,932 |
| 14 | 2021 | 186 | 212 | 52 | 450 | 8,136 | 1,246 | 0 | 9,382 | 8,932 |
| 15 | 2022 | 186 | 212 | 52 | 450 | 8,136 | 1,246 | 0 | 9,382 | 8,932 |
| 16 | 2023 | 186 | 212 | 52 | 450 | 8,136 | 1,246 | 0 | 9,382 | 8,932 |
| 17 | 2024 | 796 | 212 | 52 | 1,060 | 8,136 | 1,246 | 0 | 9,382 | 8,322 |
| 18 | 2025 | 796 | 212 | 52 | 1,060 | 8,136 | 1,246 | 0 | 9,382 | 8,322 |
| 19 | 2026 | 796 | 212 | 52 | 1,060 | 8,136 | 1,246 | 0 | 9,382 | 8,322 |
| 20 | 2027 | 186 | 212 | 160 | 558 | 8,136 | 1,246 | 0 | 9,382 | 8,824 |
| 21 | 2028 | 186 | 212 | 255 | 653 | 8,136 | 1,246 | 0 | 9,382 | 8,729 |
| 22 | 2029 | 186 | 212 | 152 | 551 | 8,136 | 1,246 | 0 | 9,382 | 8,831 |
| 23 | 2030 | 186 | 212 | 52 | 450 | 8,136 | 1,246 | 0 | 9,382 | 8,932 |
| 24 | 2031 | 186 | 212 | 52 | 450 | 8,136 | 1,246 | 0 | 9,382 | 8,932 |
| 25 | 2032 | 186 | 212 | 52 | 450 | 8,136 | 1,246 | 0 | 9,382 | 8,932 |
| 26 | 2033 | 186 | 212 | 52 | 450 | 8,136 | 1,246 | 0 | 9,382 | 8,932 |
| 27 | 2034 | 186 | 212 | 52 | 450 | 8,136 | 1,246 | 0 | 9,382 | 8,932 |
| 28 | 2035 | 186 | 212 | 52 | 450 | 8,136 | 1,246 | 0 | 9,382 | 8,932 |
| 29 | 2036 | 186 | 212 | 52 | 450 | 8,136 | 1,246 | 0 | 9,382 | 8,932 |
| 30 | 2037 | 186 | 212 | 52 | 450 | 8,136 | 1,246 | 0 | 9,382 | 8,932 |
| 31 | 2038 | 186 | 212 | 52 | 450 | 8,136 | 1,246 | 0 | 9,382 | 8,932 |
| 32 | 2039 | 796 | 212 | 52 | 1,060 | 8,136 | 1,246 | 0 | 9,382 | 8,322 |
| 33 | 2040 | 796 | 212 | 52 | 1,060 | 8,136 | 1,246 | 0 | 9,382 | 8,322 |
| 34 | 2041 | 796 | 212 | 52 | 1,060 | 8,136 | 1,246 | 0 | 9,382 | 8,322 |
| 35 | 2042 | 186 | 212 | 160 | 558 | 8,136 | 1,246 | 0 | 9,382 | 8,824 |
| 36 | 2043 | 186 | 212 | 255 | 653 | 8,136 | 1,246 | 0 | 9,382 | 8,729 |
| 37 | 2044 | 186 | 212 | 152 | 551 | 8,136 | 1,246 | 0 | 9,382 | 8,831 |

**EIRR: 23.0%** **NPV: 18.1 Billion Rupees** **B/C: 2.29**

## Table A127.1.16 Sensitivity Test of Economic Evaluation of Integrated Project

EIRR

| | | Cost | | |
|---|---|---|---|---|
| | | 0% | +10% | +20% |
| Benefit | 0% | 23.0% | 21.6% | 20.4% |
| | -10% | 21.4% | 20.1% | 18.9% |
| | -20% | 19.8% | 18.5% | 17.3% |

NPV (Rs. Million)

| | | Cost | | |
|---|---|---|---|---|
| | | 0% | +10% | +20% |
| Benefit | 0% | 18,110 | 16,710 | 15,309 |
| | -10% | 14,899 | 13,498 | 12,098 |
| | -20% | 11,687 | 10,287 | 8,886 |

B/C

| | | Cost | | |
|---|---|---|---|---|
| | | 0% | +10% | +20% |
| Benefit | 0% | 2.29 | 2.08 | 1.91 |
| | -10% | 2.06 | 1.88 | 1.72 |
| | -20% | 1.83 | 1.67 | 1.53 |

## Table A127.1.17 Financial Cost and Benefit Stream and Evaluation Indices of Water Supply Project

(Unit: Rs. Million)

| No. | Year | Cost | | | | | | Revenue | | | Balance |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Bulk Water Source*1 | | | DNI | | Total | Domestic Water | Non-domestic Water | Total | |
| | | Plants | O&M *2 | Replace-ment | Capital Invest-ment | O&M + Replace-ment | | | | | |
| 1 | 2009 | 1,381 | 0 | | | | 1,381 | 0 | 0 | 0 | -1,381 |
| 2 | 2010 | 1,427 | 0 | | | | 1,427 | 0 | 0 | 0 | -1,427 |
| 3 | 2011 | 1,476 | 0 | | | | 1,476 | 0 | 0 | 0 | -1,476 |
| 4 | 2012 | 1,371 | 101 | | 5,002 | 64 | 6,537 | 547 | 157 | 704 | -5,833 |
| 5 | 2013 | | 199 | | 5,832 | 197 | 6,228 | 1,232 | 266 | 1,498 | -4,730 |
| 6 | 2014 | | 257 | | 3,069 | 271 | 3,596 | 2,078 | 443 | 2,521 | -1,075 |
| 7 | 2015 | | 267 | | | 279 | 546 | 2,211 | 470 | 2,681 | 2,135 |
| 8 | 2016 | | 278 | | | 288 | 566 | 2,211 | 470 | 2,681 | 2,115 |
| 9 | 2017 | | 290 | | | 297 | 587 | 2,211 | 470 | 2,681 | 2,094 |
| 10 | 2018 | | 302 | | | 307 | 609 | 2,211 | 470 | 2,681 | 2,073 |
| 11 | 2019 | | 314 | | | 317 | 632 | 2,211 | 470 | 2,681 | 2,050 |
| 12 | 2020 | | 328 | | | 328 | 656 | 2,211 | 470 | 2,681 | 2,025 |
| 13 | 2021 | | 342 | | | 339 | 681 | 2,211 | 470 | 2,681 | 2,000 |
| 14 | 2022 | | 357 | | | 351 | 708 | 2,211 | 470 | 2,681 | 1,973 |
| 15 | 2023 | | 372 | | | 364 | 736 | 2,211 | 470 | 2,681 | 1,945 |
| 16 | 2024 | | 389 | 789 | | 377 | 1,555 | 2,211 | 470 | 2,681 | 1,127 |
| 17 | 2025 | | 406 | 801 | | 390 | 1,598 | 2,211 | 470 | 2,681 | 1,084 |
| 18 | 2026 | | 425 | 813 | | 405 | 1,642 | 2,211 | 470 | 2,681 | 1,039 |
| 19 | 2027 | | 444 | | | 420 | 864 | 2,211 | 470 | 2,681 | 1,817 |
| 20 | 2028 | | 465 | | | 436 | 900 | 2,211 | 470 | 2,681 | 1,781 |
| 21 | 2029 | | 486 | | | 452 | 939 | 2,211 | 470 | 2,681 | 1,743 |
| 22 | 2030 | | 509 | | | 470 | 979 | 2,211 | 470 | 2,681 | 1,703 |
| 23 | 2031 | | 533 | | | 488 | 1,021 | 2,211 | 470 | 2,681 | 1,660 |
| 24 | 2032 | | 559 | | | 508 | 1,066 | 2,211 | 470 | 2,681 | 1,615 |
| 25 | 2033 | | 585 | | | 528 | 1,113 | 2,211 | 470 | 2,681 | 1,568 |
| 26 | 2034 | | 614 | | | 549 | 1,163 | 2,211 | 470 | 2,681 | 1,518 |
| 27 | 2035 | | 644 | | | 572 | 1,216 | 2,211 | 470 | 2,681 | 1,466 |
| 28 | 2036 | | 676 | | | 596 | 1,271 | 2,211 | 470 | 2,681 | 1,410 |
| 29 | 2037 | | 709 | | | 621 | 1,330 | 2,211 | 470 | 2,681 | 1,352 |
| 30 | 2038 | | 744 | | | 647 | 1,392 | 2,211 | 470 | 2,681 | 1,290 |
| 31 | 2039 | | 782 | 986 | | 675 | 2,443 | 2,211 | 470 | 2,681 | 238 |
| 32 | 2040 | | 821 | 1,001 | | 704 | 2,527 | 2,211 | 470 | 2,681 | 155 |
| 33 | 2041 | | 863 | 2,389 | | 735 | 3,988 | 2,211 | 470 | 2,681 | -1,306 |
| 34 | 2042 | | 907 | | | 768 | 1,675 | 2,211 | 470 | 2,681 | 1,006 |
| 35 | 2043 | | 954 | | | 802 | 1,756 | 2,211 | 470 | 2,681 | 925 |
| 36 | 2044 | | 1,003 | | | 839 | 1,842 | 2,211 | 470 | 2,681 | 839 |

Remark: *1 Water source costs for the zone west were estimated as a part of the bulk water suupy system, which were calculated as a proportional amount of total zone west water demand to the total water demand in Karachi City in 2016.

*2 Replacement cost of new pipes is included in O&M cost.

**Evaluation Indices (Interest Rate: 8%)**

| | | |
|---|---|---|
| **FIRR:** | **8.3%** | |
| **NPV:** | **0.3** | **Million Rupees** |
| **B/C:** | **1.01** | |

**AverageUnit Price at Current Price in 2008**

| | Present | New Price | |
|---|---|---|---|
| Domestic | 44 | 128 | Rs./1000 gallon |
| Non-Domestic | 73 | 212 | Rs./1000 gallon |

## Table A127.1.18 Sensitivity Test of Financial Evaluation of Water Supply Project

FIRR

| | | Cost | | |
|---|---|---|---|---|
| | | 0% | +10% | +20% |
| Revenue | 0% | 8.3 | 6.5 | 4.7 |
| | -10% | 6.3 | 4.4 | 2.4 |
| | -20% | 3.9 | 1.6 | - |

NPV (Rs. Million)

| | | Cost | | |
|---|---|---|---|---|
| | | 0% | +10% | +20% |
| Revenue | 0% | 300 | -1,885 | -4,070 |
| | -10% | -1,915 | -4,100 | -6,285 |
| | -20% | -4,130 | -6,315 | -8,500 |

B/C

| | | Cost | | |
|---|---|---|---|---|
| | | 0% | +10% | +20% |
| Revenue | 0% | 1.01 | 0.92 | 0.84 |
| | -10% | 0.91 | 0.83 | 0.76 |
| | -20% | 0.81 | 0.74 | 0.68 |

Note: Discounted at rate of 8%

## Table A127.1.19 Financial Cost and Benefit Stream and Evaluation Indices of Sewerage Project

(Unit: Rs. Million)

| No. | Year | Cost | | | | Revenue | | | Balance |
|---|---|---|---|---|---|---|---|---|---|
| | | Capital Invest-ment | O&M | Replace-ment | Total | Domestic Benefit | Non-domestic Water | Total | |
| 1 | 2008 | 696 | 0 | | 696 | 0 | 0 | 0 | -696 |
| 2 | 2009 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 3 | 2010 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 4 | 2011 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 5 | 2012 | 1,917 | 0 | | 1,917 | 0 | 0 | 0 | -1,917 |
| 6 | 2013 | 1,893 | 0 | | 1,893 | 0 | 0 | 0 | -1,893 |
| 7 | 2014 | 895 | 40 | | 935 | 531 | 113 | 644 | -291 |
| 8 | 2015 | | 83 | | 83 | 553 | 118 | 670 | 587 |
| 9 | 2016 | | 86 | | 86 | 553 | 118 | 670 | 584 |
| 10 | 2017 | | 90 | | 90 | 553 | 118 | 670 | 581 |
| 11 | 2018 | | 93 | | 93 | 553 | 118 | 670 | 577 |
| 12 | 2019 | | 97 | | 97 | 553 | 118 | 670 | 573 |
| 13 | 2020 | | 101 | | 101 | 553 | 118 | 670 | 569 |
| 14 | 2021 | | 105 | | 105 | 553 | 118 | 670 | 565 |
| 15 | 2022 | | 110 | | 110 | 553 | 118 | 670 | 561 |
| 16 | 2023 | | 114 | | 114 | 553 | 118 | 670 | 556 |
| 17 | 2024 | | 119 | | 119 | 553 | 118 | 670 | 551 |
| 18 | 2025 | | 124 | | 124 | 553 | 118 | 670 | 546 |
| 19 | 2026 | | 130 | | 130 | 553 | 118 | 670 | 540 |
| 20 | 2027 | | 136 | 125 | 261 | 553 | 118 | 670 | 409 |
| 21 | 2028 | | 142 | 243 | 384 | 553 | 118 | 670 | 286 |
| 22 | 2029 | | 148 | 124 | 272 | 553 | 118 | 670 | 398 |
| 23 | 2030 | | 155 | | 155 | 553 | 118 | 670 | 515 |
| 24 | 2031 | | 162 | | 162 | 553 | 118 | 670 | 508 |
| 25 | 2032 | | 170 | | 170 | 553 | 118 | 670 | 501 |
| 26 | 2033 | | 177 | | 177 | 553 | 118 | 670 | 493 |
| 27 | 2034 | | 186 | | 186 | 553 | 118 | 670 | 484 |
| 28 | 2035 | | 195 | | 195 | 553 | 118 | 670 | 476 |
| 29 | 2036 | | 204 | | 204 | 553 | 118 | 670 | 466 |
| 30 | 2037 | | 214 | | 214 | 553 | 118 | 670 | 456 |
| 31 | 2038 | | 224 | | 224 | 553 | 118 | 670 | 446 |
| 32 | 2039 | | 235 | | 235 | 553 | 118 | 670 | 435 |
| 33 | 2040 | | 247 | | 247 | 553 | 118 | 670 | 423 |
| 34 | 2041 | | 259 | | 259 | 553 | 118 | 670 | 411 |
| 35 | 2042 | | 272 | 375 | 648 | 553 | 118 | 670 | 22 |
| 36 | 2043 | | 286 | 388 | 675 | 553 | 118 | 670 | -4 |
| 37 | 2044 | | 301 | 197 | 497 | 553 | 118 | 670 | 173 |

Remark: The existging fixed assets of sewerage systems were carried over into the priority project.
TP3 system accounts for 41.8% of the total sunk cost (Rs.1.66 billion) in 2008.
TP1 system accounts of the total sunk cost (Rs.0.88 billion) in 2014.

**Evaluation Indices (Interest rate: 8%)**

**FIRR: 8.2%**
**NPV: -848 Million Rupees**
**B/C: 0.76**

**Average Unit Price of Sewerage Service at Current Price in 200**

Present Rate: **25%** of Water Supply Tariff
New Rate: **50%** of Water Supply Tariff

## Table A127.1.20 Sensitivity Test of Financial Evaluation of Sewerage Project

**FIRR**

| | | Cost | | |
|---|---|---|---|---|
| | | 0% | +10% | +20% |
| Revenue | 0% | 8.2 | 7.0 | 5.8 |
| | -10% | 6.8 | 5.5 | 4.3 |
| | -20% | 5.2 | 3.9 | 2.8 |

**NPV (Rs. Million)**

| | | Cost | | |
|---|---|---|---|---|
| | | 0% | +10% | +20% |
| Revenue | 0% | 83 | -386 | -856 |
| | -10% | -395 | -864 | -1,334 |
| | -20% | -873 | -1,342 | -1,812 |

**B/C**

| | | Cost | | |
|---|---|---|---|---|
| | | 0% | +10% | +20% |
| Revenue | 0% | 1.02 | 0.93 | 0.85 |
| | -10% | 0.92 | 0.83 | 0.76 |
| | -20% | 0.81 | 0.74 | 0.68 |

Note: Discounted at rate of 8%

## Table A127.1.21 Financial Cost and Benefit Stream and Evaluation Indices of Integrated Project

(Unit: Rs. Million)

| No. | Year | Cost | | | | Revenue | | | Balance |
|---|---|---|---|---|---|---|---|---|---|
| | | Water Supply | | Sewerage System | Total | Water Supply Benefits | Sewerage Benefits | Total | |
| | | Water Source | Distribution | | | | | | |
| 1 | 2008 | 0 | 0 | 696 | 696 | 0 | 0 | 0 | -696 |
| 2 | 2009 | 1,381 | 0 | 0 | 1,381 | 0 | 0 | 0 | -1,381 |
| 3 | 2010 | 1,427 | 0 | 0 | 1,427 | 0 | 0 | 0 | -1,427 |
| 4 | 2011 | 1,476 | 0 | 0 | 1,476 | 0 | 0 | 0 | -1,476 |
| 5 | 2012 | 1,472 | 5,065 | 1,917 | 8,454 | 704 | 0 | 704 | -7,751 |
| 6 | 2013 | 199 | 6,029 | 1,893 | 8,121 | 1,498 | 0 | 1,498 | -6,622 |
| 7 | 2014 | 257 | 3,339 | 935 | 4,532 | 2,521 | 644 | 3,165 | -1,366 |
| 8 | 2015 | 267 | 279 | 83 | 629 | 2,681 | 670 | 3,352 | 2,722 |
| 9 | 2016 | 278 | 288 | 86 | 652 | 2,681 | 670 | 3,352 | 2,699 |
| 10 | 2017 | 290 | 297 | 90 | 677 | 2,681 | 670 | 3,352 | 2,675 |
| 11 | 2018 | 302 | 307 | 93 | 702 | 2,681 | 670 | 3,352 | 2,650 |
| 12 | 2019 | 314 | 317 | 97 | 729 | 2,681 | 670 | 3,352 | 2,623 |
| 13 | 2020 | 328 | 328 | 101 | 757 | 2,681 | 670 | 3,352 | 2,595 |
| 14 | 2021 | 342 | 339 | 105 | 787 | 2,681 | 670 | 3,352 | 2,565 |
| 15 | 2022 | 357 | 351 | 110 | 818 | 2,681 | 670 | 3,352 | 2,534 |
| 16 | 2023 | 372 | 364 | 114 | 850 | 2,681 | 670 | 3,352 | 2,501 |
| 17 | 2024 | 1,178 | 377 | 119 | 1,674 | 2,681 | 670 | 3,352 | 1,678 |
| 18 | 2025 | 1,207 | 390 | 124 | 1,722 | 2,681 | 670 | 3,352 | 1,630 |
| 19 | 2026 | 1,238 | 405 | 130 | 1,772 | 2,681 | 670 | 3,352 | 1,580 |
| 20 | 2027 | 444 | 420 | 261 | 1,125 | 2,681 | 670 | 3,352 | 2,227 |
| 21 | 2028 | 465 | 436 | 384 | 1,285 | 2,681 | 670 | 3,352 | 2,067 |
| 22 | 2029 | 486 | 452 | 272 | 1,211 | 2,681 | 670 | 3,352 | 2,141 |
| 23 | 2030 | 509 | 470 | 155 | 1,134 | 2,681 | 670 | 3,352 | 2,218 |
| 24 | 2031 | 533 | 488 | 162 | 1,183 | 2,681 | 670 | 3,352 | 2,168 |
| 25 | 2032 | 559 | 508 | 170 | 1,236 | 2,681 | 670 | 3,352 | 2,116 |
| 26 | 2033 | 585 | 528 | 177 | 1,291 | 2,681 | 670 | 3,352 | 2,061 |
| 27 | 2034 | 614 | 549 | 186 | 1,349 | 2,681 | 670 | 3,352 | 2,003 |
| 28 | 2035 | 644 | 572 | 195 | 1,411 | 2,681 | 670 | 3,352 | 1,941 |
| 29 | 2036 | 676 | 596 | 204 | 1,475 | 2,681 | 670 | 3,352 | 1,876 |
| 30 | 2037 | 709 | 621 | 214 | 1,544 | 2,681 | 670 | 3,352 | 1,808 |
| 31 | 2038 | 744 | 647 | 224 | 1,616 | 2,681 | 670 | 3,352 | 1,736 |
| 32 | 2039 | 1,768 | 675 | 235 | 2,679 | 2,681 | 670 | 3,352 | 673 |
| 33 | 2040 | 1,823 | 704 | 247 | 2,774 | 2,681 | 670 | 3,352 | 578 |
| 34 | 2041 | 3,252 | 735 | 259 | 4,247 | 2,681 | 670 | 3,352 | -895 |
| 35 | 2042 | 907 | 768 | 648 | 2,323 | 2,681 | 670 | 3,352 | 1,029 |
| 36 | 2043 | 954 | 802 | 675 | 2,431 | 2,681 | 670 | 3,352 | 921 |
| 37 | 2044 | 1,003 | 839 | 497 | 2,339 | 2,681 | 670 | 3,352 | 1,012 |

**Evaluation Indices (Interest rate: 8%)**

| | | |
|---|---|---|
| **FIRR:** | **8.3%** | |
| **NPV:** | **361** | **Million Rupees** |
| **B/C:** | **1.01** | |

**AverageUnit Price at Current Price in 2008**

| | Present | New Price | |
|---|---|---|---|
| Domestic | 44 | 128 | Rs./1000 gallon |
| Non-Domestic | 73 | 212 | Rs./1000 gallon |
| Sewerage | 25% | 50% | of Water Charge |

## Table A127.1.22 Sensitivity Test of Financial Evaluation of Integrated Project

**FIRR**

| | | Cost | | |
|---|---|---|---|---|
| | | 0% | +10% | +20% |
| Revenue | 0% | 8.3 | 6.6 | 5.0 |
| | -10% | 6.4 | 4.7 | 2.9 |
| | -20% | 4.2 | 2.3 | 0.0 |

**NPV (Rs. Million)**

| | | Cost | | |
|---|---|---|---|---|
| | | 0% | +10% | +20% |
| Revenue | 0% | 361 | -2,132 | -3,968 |
| | -10% | -2,168 | -4,660 | -7,153 |
| | -20% | -4,697 | -7,189 | -9,682 |

**B/C**

| | | Cost | | |
|---|---|---|---|---|
| | | 0% | +10% | +20% |
| Revenue | 0% | 1.01 | 0.92 | 0.86 |
| | -10% | 0.91 | 0.83 | 0.76 |
| | -20% | 0.81 | 0.74 | 0.68 |

Note: Discounted at rate of 8%

## Table 127.1.23 (1/3) Profit and Loss Table of West Water and Sewerage Company: 2012-2038 (1/2)

(Unit: Rs. Billion)

| Item | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I. Operating Revenue | **3.48** | **4.39** | **5.87** | **7.82** | **10.28** | **12.22** | **12.22** | **12.22** | **13.34** | **13.34** | **13.34** | **14.58** | **14.58** | **14.58** |
| 1. Water Sales | 1.75 | 2.40 | 3.42 | 4.83 | 6.62 | 8.03 | 8.03 | 8.03 | 8.83 | 8.83 | 8.83 | 9.71 | 9.71 | 9.71 |
| (1) Domestic | 1.29 | 1.81 | 2.65 | 3.62 | 4.91 | 5.84 | 5.84 | 5.84 | 6.42 | 6.42 | 6.42 | 7.06 | 7.06 | 7.06 |
| (2) Non-domestic | 0.47 | 0.58 | 0.77 | 1.21 | 1.71 | 2.19 | 2.19 | 2.19 | 2.41 | 2.41 | 2.41 | 2.65 | 2.65 | 2.65 |
| 2. Sewerage Service | 1.73 | 1.99 | 2.45 | 2.99 | 3.66 | 4.19 | 4.19 | 4.19 | 4.52 | 4.52 | 4.52 | 4.87 | 4.87 | 4.87 |
| (1) Domestic | 0.85 | 1.02 | 1.34 | 1.64 | 2.02 | 2.33 | 2.33 | 2.33 | 2.57 | 2.57 | 2.57 | 2.82 | 2.82 | 2.82 |
| (2) Non-domestic | 0.08 | 0.13 | 0.21 | 0.42 | 0.66 | 0.88 | 0.88 | 0.88 | 0.96 | 0.96 | 0.96 | 1.06 | 1.06 | 1.06 |
| (3) Sewage Receiving | 0.80 | 0.85 | 0.89 | 0.94 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |
| II. Operating Expenses | **6.12** | **6.55** | **7.27** | **8.42** | **8.97** | **8.78** | **8.87** | **8.94** | **9.02** | **9.11** | **9.19** | **8.91** | **9.00** | **9.11** |
| 1. Operation Costs | 4.90 | 5.24 | 5.81 | 6.74 | 7.18 | 7.02 | 7.09 | 7.15 | 7.22 | 7.29 | 7.36 | 7.12 | 7.20 | 7.28 |
| (1) Water Supply | 4.80 | 5.14 | 5.38 | 5.77 | 6.18 | 6.03 | 6.08 | 6.13 | 6.18 | 6.23 | 6.29 | 6.04 | 6.10 | 6.17 |
| 1) Electricity | 0.46 | 0.55 | 0.57 | 0.60 | 0.62 | 0.65 | 0.68 | 0.71 | 0.74 | 0.78 | 0.81 | 0.85 | 0.88 | 0.92 |
| 2) Compensation | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| 3) Water Source Cost | 1.89 | 1.96 | 2.03 | 2.10 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 |
| 4) Depreciation | 1.82 | 2.06 | 2.19 | 2.47 | 2.76 | 2.57 | 2.58 | 2.58 | 2.59 | 2.60 | 2.60 | 2.31 | 2.32 | 2.33 |
| 5) Others | 0.60 | 0.55 | 0.57 | 0.58 | 0.59 | 0.60 | 0.61 | 0.62 | 0.63 | 0.65 | 0.66 | 0.67 | 0.69 | 0.70 |
| (2) Sewerage | 0.10 | 0.10 | 0.43 | 0.97 | 0.99 | 0.99 | 1.02 | 1.03 | 1.04 | 1.05 | 1.07 | 1.08 | 1.10 | 1.11 |
| 1) Electricity | 0.00 | 0.00 | 0.02 | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.06 | 0.06 | 0.06 |
| 2) Compensation | 0.00 | 0.00 | 0.01 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 |
| 3) Depreciation | 0.07 | 0.07 | 0.31 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 |
| 4) Others | 0.03 | 0.03 | 0.10 | 0.21 | 0.23 | 0.23 | 0.25 | 0.25 | 0.26 | 0.27 | 0.28 | 0.29 | 0.30 | 0.32 |
| 2. Others | 1.22 | 1.31 | 1.45 | 1.68 | 1.79 | 1.76 | 1.77 | 1.79 | 1.80 | 1.82 | 1.84 | 1.78 | 1.80 | 1.82 |
| III. Net Operating Revenue/Deficit | **-2.64** | **-2.16** | **-1.40** | **-0.60** | **1.31** | **3.44** | **3.36** | **3.28** | **4.32** | **4.24** | **4.15** | **5.68** | **5.58** | **5.48** |
| IV. Non-operating Profit/Loss | -0.91 | -1.06 | -1.56 | -2.71 | -4.06 | -4.16 | -4.12 | -4.06 | -4.06 | -3.98 | -3.89 | -3.85 | -3.71 | -3.55 |
| 1. Non-operating Income | 0.00 | 0.38 | 0.24 | 0.30 | 0.17 | 0.06 | 0.11 | 0.16 | 0.22 | 0.30 | 0.39 | 0.46 | 0.54 | 0.62 |
| (1) Interest Revenue | 0.00 | 0.38 | 0.24 | 0.30 | 0.17 | 0.06 | 0.11 | 0.16 | 0.22 | 0.30 | 0.39 | 0.46 | 0.54 | 0.62 |
| (2) Other Revenues | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. Non-operating Expenses | 0.91 | 1.44 | 1.80 | 3.01 | 4.23 | 4.22 | 4.22 | 4.22 | 4.28 | 4.28 | 4.28 | 4.31 | 4.25 | 4.17 |
| (1) Long-term Interest (New Loans) | 0.77 | 1.26 | 1.55 | 2.67 | 3.76 | 3.66 | 3.66 | 3.66 | 3.66 | 3.66 | 3.66 | 3.63 | 3.57 | 3.49 |
| (2) Short-term Interest | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (3) Bad Debt Expense | 0.13 | 0.18 | 0.25 | 0.34 | 0.46 | 0.56 | 0.56 | 0.56 | 0.62 | 0.62 | 0.62 | 0.68 | 0.68 | 0.68 |
| V. Ordinary Profit/Loss | -3.55 | -3.22 | -2.96 | -3.31 | -2.75 | -0.72 | -0.76 | -0.78 | 0.26 | 0.26 | 0.26 | 1.83 | 1.87 | 1.92 |
| VI. Profit Tax | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.09 | 0.09 | 0.64 | 0.65 | 0.67 |
| VII. Profit after Tax | -3.55 | -3.22 | -2.96 | -3.31 | -2.75 | -0.72 | -0.76 | -0.78 | 0.17 | 0.17 | 0.17 | 1.19 | 1.21 | 1.25 |
| VIII. Stock Dividend | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| IX Net Profit/Deficit | **-3.55** | **-3.22** | **-2.96** | **-3.31** | **-2.75** | **-0.72** | **-0.76** | **-0.78** | **0.17** | **0.17** | **0.17** | **1.19** | **1.21** | **1.25** |
| 1. Balance for Previous Years at Beginning of the Year | 0.00 | -3.55 | -6.77 | -9.72 | -13.03 | -15.78 | -16.51 | -17.27 | -18.05 | -17.88 | -17.71 | -17.54 | -16.36 | -15.14 |
| 2. Balance of Accumulated Profit/Deficit at End of the ` | **-3.55** | **-6.77** | **-9.72** | **-13.03** | **-15.78** | **-16.51** | **-17.27** | **-18.05** | **-17.88** | **-17.71** | **-17.54** | **-16.36** | **-15.14** | **-13.89** |

## Table 127.1.23 (1/3) Profit and Loss Table of West Water and Sewerage Company: 2012-2038 (2/2)

(Unit: Rs. Billion)

| Item | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I. Operating Revenue | **15.94** | **15.94** | **15.94** | **17.44** | **17.44** | **17.44** | **19.08** | **19.08** | **19.08** | **20.89** | **20.89** | **20.89** | **22.88** |
| 1. Water Sales | 10.68 | 10.68 | 10.68 | 11.75 | 11.75 | 11.75 | 12.93 | 12.93 | 12.93 | 14.22 | 14.22 | 14.22 | 15.64 |
| (1) Domestic | 7.77 | 7.77 | 7.77 | 8.54 | 8.54 | 8.54 | 9.40 | 9.40 | 9.40 | 10.34 | 10.34 | 10.34 | 11.37 |
| (2) Non-domestic | 2.92 | 2.92 | 2.92 | 3.21 | 3.21 | 3.21 | 3.53 | 3.53 | 3.53 | 3.88 | 3.88 | 3.88 | 4.27 |
| 2. Sewerage Service | 5.26 | 5.26 | 5.26 | 5.68 | 5.68 | 5.68 | 6.15 | 6.15 | 6.15 | 6.67 | 6.67 | 6.67 | 7.24 |
| (1) Domestic | 3.11 | 3.11 | 3.11 | 3.42 | 3.42 | 3.42 | 3.76 | 3.76 | 3.76 | 4.14 | 4.14 | 4.14 | 4.55 |
| (2) Non-domestic | 1.17 | 1.17 | 1.17 | 1.28 | 1.28 | 1.28 | 1.41 | 1.41 | 1.41 | 1.55 | 1.55 | 1.55 | 1.71 |
| (3) Sewage Receiving | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |
| II. Operating Expenses | **9.30** | **9.01** | **9.08** | **9.08** | **9.08** | **9.29** | **9.08** | **9.31** | **9.56** | **9.82** | **10.08** | **10.33** | **10.60** |
| 1. Operation Costs | 7.44 | 7.21 | 7.26 | 7.26 | 7.27 | 7.43 | 7.26 | 7.45 | 7.65 | 7.85 | 8.07 | 8.27 | 8.48 |
| (1) Water Supply | 6.31 | 6.08 | 6.11 | 6.19 | 6.21 | 6.23 | 6.08 | 6.24 | 6.41 | 6.59 | 6.78 | 6.95 | 7.12 |
| 1) Electricity | 0.96 | 1.01 | 1.05 | 1.10 | 1.15 | 1.20 | 1.25 | 1.31 | 1.37 | 1.43 | 1.49 | 1.56 | 1.63 |
| 2) Compensation | 0.05 | 0.05 | 0.05 | 0.05 | 0.06 | 0.06 | 0.06 | 0.06 | 0.07 | 0.07 | 0.07 | 0.07 | 0.08 |
| 3) Water Source Cost | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 |
| 4) Depreciation | 2.40 | 2.12 | 2.08 | 2.08 | 2.04 | 1.98 | 1.75 | 1.83 | 1.91 | 2.00 | 2.09 | 2.15 | 2.22 |
| 5) Others | 0.72 | 0.74 | 0.75 | 0.77 | 0.79 | 0.82 | 0.84 | 0.87 | 0.89 | 0.92 | 0.95 | 0.99 | 1.02 |
| (2) Sewerage | 1.13 | 1.13 | 1.15 | 1.08 | 1.06 | 1.20 | 1.18 | 1.21 | 1.23 | 1.26 | 1.29 | 1.32 | 1.35 |
| 1) Electricity | 0.06 | 0.07 | 0.07 | 0.07 | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.09 | 0.10 | 0.10 | 0.11 |
| 2) Compensation | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.06 | 0.06 | 0.06 | 0.06 | 0.07 | 0.07 | 0.07 |
| 3) Depreciation | 0.69 | 0.67 | 0.68 | 0.58 | 0.54 | 0.66 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 |
| 4) Others | 0.33 | 0.34 | 0.36 | 0.37 | 0.39 | 0.40 | 0.42 | 0.44 | 0.46 | 0.48 | 0.50 | 0.52 | 0.55 |
| 2. Others | 1.86 | 1.80 | 1.82 | 1.82 | 1.82 | 1.86 | 1.82 | 1.86 | 1.91 | 1.96 | 2.02 | 2.07 | 2.12 |
| III. Net Operating Revenue/Deficit | **6.64** | **6.93** | **6.87** | **8.36** | **8.35** | **8.15** | **10.00** | **9.77** | **9.52** | **11.07** | **10.81** | **10.56** | **12.29** |
| IV. Non-operating Profit/Loss | -3.43 | -3.24 | -3.02 | -2.87 | -2.62 | -2.44 | -2.35 | -2.21 | -2.06 | -2.01 | -1.85 | -1.67 | -1.58 |
| 1. Non-operating Income | 0.68 | 0.69 | 0.72 | 0.77 | 0.84 | 0.83 | 0.82 | 0.78 | 0.74 | 0.70 | 0.68 | 0.67 | 0.67 |
| (1) Interest Revenue | 0.68 | 0.69 | 0.72 | 0.77 | 0.84 | 0.83 | 0.82 | 0.78 | 0.74 | 0.70 | 0.68 | 0.67 | 0.67 |
| (2) Other Revenues | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. Non-operating Expenses | 4.11 | 3.93 | 3.74 | 3.64 | 3.45 | 3.27 | 3.17 | 2.98 | 2.80 | 2.71 | 2.53 | 2.34 | 2.26 |
| (1) Long-term Interest (New Loans) | 3.36 | 3.18 | 3.00 | 2.81 | 2.63 | 2.45 | 2.26 | 2.08 | 1.90 | 1.71 | 1.53 | 1.35 | 1.16 |
| (2) Short-term Interest | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (3) Bad Debt Expense | 0.75 | 0.75 | 0.75 | 0.82 | 0.82 | 0.82 | 0.90 | 0.90 | 0.90 | 1.00 | 1.00 | 1.00 | 1.09 |
| V. Ordinary Profit/Loss | 3.21 | 3.69 | 3.85 | 5.49 | 5.74 | 5.70 | 7.65 | 7.56 | 7.46 | 9.06 | 8.96 | 8.88 | 10.70 |
| VI. Profit Tax | 1.12 | 1.29 | 1.35 | 1.92 | 2.01 | 2.00 | 2.68 | 2.65 | 2.61 | 3.17 | 3.14 | 3.11 | 3.75 |
| VII. Profit after Tax | 2.09 | 2.40 | 2.50 | 3.57 | 3.73 | 3.71 | 4.97 | 4.91 | 4.85 | 5.89 | 5.82 | 5.78 | 6.96 |
| VIII Stock Dividend | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.44 | 4.44 | 4.44 | 4.44 | 4.44 | 4.44 | 4.44 |
| IX Net Profit/Deficit | **2.09** | **2.40** | **2.50** | **3.57** | **3.73** | **3.71** | **0.53** | **0.47** | **0.41** | **1.45** | **1.38** | **1.34** | **2.52** |
| 1. Balance for Previous Years at Beginning of the Year | -13.89 | -11.80 | -9.40 | -6.90 | -3.33 | 0.40 | 4.10 | 4.64 | 5.11 | 5.52 | 6.97 | 8.35 | 9.69 |
| 2. Balance of Accumulated Profit/Deficit at End of the Year | **-11.80** | **-9.40** | **-6.90** | **-3.33** | **0.40** | **4.10** | **4.64** | **5.11** | **5.52** | **6.97** | **8.35** | **9.69** | **12.20** |

## Table 127.1.23 (2/3) Cash Flow Table of West Water and Sewerage Company: 2012-2038 (1/2)

(Unit: Rs. Billion)

| Item | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **I. Procurement** | | | | | | | | | | | | | | |
| 1. Operating Revenue | 2.68 | 3.54 | 4.98 | 6.89 | 9.30 | 11.24 | 11.24 | 11.24 | 12.36 | 12.36 | 12.36 | 13.60 | 13.60 | 13.60 |
| 2. Sewage Receiving | 0.80 | 0.85 | 0.89 | 0.94 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |
| 3. Depreciation | 1.88 | 2.13 | 2.49 | 3.17 | 3.46 | 3.26 | 3.27 | 3.28 | 3.28 | 3.29 | 3.30 | 3.00 | 3.01 | 3.02 |
| 4. Account Receivable*1 | -0.44 | -0.14 | -0.24 | -0.31 | -0.39 | -0.32 | 0.00 | 0.00 | -0.18 | 0.00 | 0.00 | -0.20 | 0.00 | 0.00 |
| 5. Interest Revenue from Saving | 0.00 | 0.38 | 0.24 | 0.30 | 0.17 | 0.06 | 0.11 | 0.16 | 0.22 | 0.30 | 0.39 | 0.46 | 0.54 | 0.62 |
| Gross Internal Cash Position | 4.92 | 6.75 | 8.37 | 10.98 | 13.51 | 15.23 | 15.60 | 15.66 | 16.67 | 16.94 | 17.03 | 17.84 | 18.13 | 18.22 |
| 1. Capital Infusion | 14.00 | | | | | | | | | | | | | |
| 2. Existing Facilities Taken Over | 12.15 | | | | | | | | | | | | | |
| 3. Donation of Existing Facilities | 18.25 | | | | | | | | | | | | | |
| 4. Foreign Loan (Existing) | 6.00 | | | | | | | | | | | | | |
| 5. Foreign Loan (New Loans) | 8.60 | 6.10 | 3.80 | 12.70 | 13.20 | | | | | | | | | |
| 6. Government Assistance | 0.00 | | | | | | | | | | | | | |
| 7. Short-term Borrowing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total Sources | 63.92 | 12.85 | 12.17 | 23.68 | 26.71 | 15.23 | 15.60 | 15.66 | 16.67 | 16.94 | 17.03 | 17.84 | 18.13 | 18.22 |
| **II. Disbursement** | | | | | | | | | | | | | | |
| 1. Investment | 41.15 | | | | | | | | | | | | | |
| (1) Existing Facilities Taken Over | 12.15 | | | | | | | | | | | | | |
| (2) Donation from KW&SB | 18.25 | | | | | | | | | | | | | |
| (3) Water Supply Facilities | 8.43 | 5.81 | 3.06 | 6.65 | 6.85 | | | | | | | | | |
| (4) Sewerage Facilities | 2.32 | 1.77 | 1.72 | 9.28 | 9.68 | | | | | | | | | |
| (5) Replacement of Water Supply | | | | | | 0.16 | 0.16 | 0.16 | 0.17 | 0.17 | 0.17 | 0.17 | 0.21 | 0.22 |
| (6) Replacement of Sewerage | | | | | | | | | | | | | | |
| 2. Debt Services | 1.71 | 2.12 | 2.38 | 3.47 | 4.53 | 4.39 | 4.36 | 4.33 | 4.29 | 4.26 | 4.66 | 4.89 | 4.99 | 5.52 |
| (1) Principal Repayment (Transferred) | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| (2) Principal Repayment (New Loans) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.43 | 0.74 | 0.93 | 1.56 |
| (3) Financial Charges (Transferred) | 0.54 | 0.46 | 0.43 | 0.40 | 0.36 | 0.33 | 0.30 | 0.26 | 0.23 | 0.20 | 0.17 | 0.13 | 0.10 | 0.07 |
| (4) Financial Charges (New Loans) | 0.77 | 1.26 | 1.55 | 2.67 | 3.76 | 3.66 | 3.66 | 3.66 | 3.66 | 3.66 | 3.66 | 3.63 | 3.57 | 3.49 |
| 3. Debt Services for Short Financing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (1) Principal Repayment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Financial Charges | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 4. Deferred Assets | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5. Inventory Stock*2 | 0.19 | 0.17 | 0.20 | 0.24 | 0.25 | 0.25 | 0.26 | 0.26 | 0.27 | 0.28 | 0.28 | 0.29 | 0.30 | 0.31 |
| 6. Other Disbursement | 4.24 | 4.42 | 4.77 | 5.26 | 5.51 | 5.52 | 5.60 | 5.67 | 5.74 | 5.82 | 5.90 | 5.90 | 5.99 | 6.09 |
| 7. Profit Tax | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.09 | 0.09 | 0.64 | 0.65 | 0.67 |
| Total Disbursement | 48.29 | 6.72 | 7.35 | 8.96 | 10.29 | 10.16 | 10.21 | 10.26 | 10.39 | 10.44 | 10.93 | 11.73 | 11.94 | 12.58 |
| **III. Net Cash Flow** | **15.64** | **6.13** | **4.82** | **14.72** | **16.43** | **5.07** | **5.39** | **5.41** | **6.27** | **6.49** | **6.10** | **6.11** | **6.19** | **5.64** |
| **IV. Opening Cash Balance** | 0.00 | 15.64 | 21.77 | 26.59 | 41.31 | 57.73 | 62.80 | 68.19 | 73.60 | 79.87 | 86.36 | 92.47 | 98.58 | 104.77 |
| **V. Accumulated Cash Position** | **15.64** | **21.77** | **26.59** | **41.31** | **57.73** | **62.80** | **68.19** | **73.60** | **79.87** | **86.36** | **92.47** | **98.58** | **104.77** | **110.41** |

Note: *1 Turnover of account receivable was assumed at 6.1
*2 Inventory Stock ws assumed as 30% of annual consumption.

## Table 127.1.23 (2/3) Cash Flow Table of West Water and Sewerage Company: 2012-2038 (2/2)

(Unit: Rs. Billion)

| Item | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **I. Procurement** | | | | | | | | | | | | | |
| 1. Operating Revenue | 14.96 | 14.96 | 14.96 | 16.45 | 16.45 | 16.45 | 18.10 | 18.10 | 18.10 | 19.91 | 19.91 | 19.91 | 21.90 |
| 2. Sewage Receiving | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |
| 3. Depreciation | 3.10 | 2.79 | 2.75 | 2.67 | 2.58 | 2.65 | 2.38 | 2.45 | 2.54 | 2.62 | 2.71 | 2.78 | 2.85 |
| 4. Account Receivable*1 | -0.22 | 0.00 | 0.00 | -0.25 | 0.00 | 0.00 | -0.27 | 0.00 | 0.00 | -0.30 | 0.00 | 0.00 | -0.33 |
| 5. Interest Revenue from Saving | 0.68 | 0.69 | 0.72 | 0.77 | 0.84 | 0.83 | 0.82 | 0.78 | 0.74 | 0.70 | 0.68 | 0.67 | 0.67 |
| Gross Internal Cash Position | 19.49 | 19.42 | 19.42 | 20.63 | 20.85 | 20.91 | 22.01 | 22.31 | 22.36 | 23.92 | 24.28 | 24.34 | 26.08 |
| 1. Capital Infusion | | | | | | | | | | | | | |
| 2. Existing Facilities Taken Over | | | | | | | | | | | | | |
| 3. Donation of Existing Facilities | | | | | | | | | | | | | |
| 4. Foreign Loan (Existing) | | | | | | | | | | | | | |
| 5. Foreign Loan (New Loans) | | | | | | | | | | | | | |
| 6. Government Assistance | | | | | | | | | | | | | |
| 7. Short-term Borrowing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total Sources | 19.49 | 19.42 | 19.42 | 20.63 | 20.85 | 20.91 | 22.01 | 22.31 | 22.36 | 23.92 | 24.28 | 24.34 | 26.08 |
| **II. Disbursement** | | | | | | | | | | | | | |
| 1. Investment | | | | | | | | | | | | | |
| (1) Existing Facilities Taken Over | | | | | | | | | | | | | |
| (2) Donation from KW&SB | | | | | | | | | | | | | |
| (3) Water Supply Facilities | | | | | | | | | | | | | |
| (4) Sewerage Facilities | | | | | | | | | | | | | |
| (5) Replacement of Water Supply | 1.85 | 1.36 | 1.38 | 1.42 | 1.54 | 1.58 | 1.76 | 1.95 | 2.07 | 2.14 | 2.11 | 1.70 | 1.72 |
| (6) Replacement of Sewerage | | 0.12 | 0.12 | 0.01 | 2.81 | 2.86 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. Debt Services | 6.01 | 5.40 | 5.22 | 5.03 | 4.85 | 4.67 | 4.48 | 4.30 | 4.12 | 3.93 | 3.75 | 3.57 | 3.38 |
| (1) Principal Repayment (Transferred) | 0.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Principal Repayment (New Loans) | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 |
| (3) Financial Charges (Transferred) | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (4) Financial Charges (New Loans) | 3.36 | 3.18 | 3.00 | 2.81 | 2.63 | 2.45 | 2.26 | 2.08 | 1.90 | 1.71 | 1.53 | 1.35 | 1.16 |
| 3. Debt Services for Short Financing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (1) Principal Repayment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Financial Charges | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 4. Deferred Assets | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5. Inventory Stock*2 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 | 0.37 | 0.38 | 0.39 | 0.41 | 0.42 | 0.44 | 0.45 | 0.47 |
| 6. Other Disbursement | 6.20 | 6.22 | 6.32 | 6.41 | 6.50 | 6.64 | 6.70 | 6.86 | 7.02 | 7.19 | 7.37 | 7.56 | 7.75 |
| 7. Profit Tax | 1.12 | 1.29 | 1.35 | 1.92 | 2.01 | 2.00 | 2.68 | 2.65 | 2.61 | 3.17 | 3.14 | 3.11 | 3.75 |
| Total Disbursement | 13.65 | 13.24 | 13.22 | 13.71 | 13.72 | 13.67 | 14.24 | 14.20 | 14.15 | 14.72 | 14.70 | 14.69 | 15.35 |
| **III. Net Cash Flow** | **5.84** | **6.18** | **6.20** | **6.92** | **7.14** | **7.24** | **7.76** | **8.12** | **8.20** | **9.20** | **9.58** | **9.65** | **10.73** |
| **IV. Opening Cash Balance** | 110.41 | 116.25 | 122.43 | 128.63 | 135.55 | 142.69 | 149.93 | 157.69 | 165.81 | 174.01 | 183.21 | 192.79 | 202.44 |
| **V. Accumulated Cash Position** | **116.25** | **122.43** | **128.63** | **135.55** | **142.69** | **149.93** | **157.69** | **165.81** | **174.01** | **183.21** | **192.79** | **202.44** | **213.17** |

## Table 127.1.23 (3/3) Balance Sheet of West Water and Sewerage Company: 2012-2038 (1/2)

(Unit: Rs. Billion)

| Item | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **I. Assets** | **55.05** | **57.93** | **58.38** | **67.37** | **77.42** | **76.29** | **75.13** | **73.95** | **73.72** | **73.49** | **72.83** | **72.88** | **72.77** | **72.06** |
| 1. Fixed Assets | 41.58 | 48.80 | 47.00 | 59.92 | 73.15 | 70.05 | 66.94 | 63.82 | 60.71 | 57.58 | 54.46 | 51.63 | 48.83 | 46.03 |
| (1) Fixed Assets | 41.15 | 48.73 | 53.50 | 69.59 | 86.28 | 86.44 | 86.60 | 86.76 | 86.93 | 87.10 | 87.27 | 87.44 | 87.65 | 87.87 |
| (2) Accumulated Depreciation | -1.88 | -4.01 | -6.50 | -9.67 | -13.13 | -16.39 | -19.66 | -22.94 | -26.22 | -29.51 | -32.81 | -35.81 | -38.82 | -41.84 |
| (3) Works in Progress | 2.32 | 4.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. Current Assets | 13.47 | | | | | | | | | | | | | |
| (1) Cash | 1.91 | 1.23 | 1.52 | 0.86 | 0.30 | 0.54 | 0.83 | 1.12 | 1.52 | 1.95 | 2.32 | 2.71 | 3.11 | 3.42 |
| (2) Bank Deposit | 10.80 | 6.97 | 8.60 | 4.88 | 1.73 | 3.06 | 4.70 | 6.34 | 8.59 | 11.04 | 13.13 | 15.34 | 17.62 | 19.39 |
| (3) Account Receivable | 0.44 | 0.58 | 0.82 | 1.13 | 1.52 | 1.84 | 1.84 | 1.84 | 2.03 | 2.03 | 2.03 | 2.23 | 2.23 | 2.23 |
| (4) Allowance for Doubtful Account | 0.13 | 0.18 | 0.25 | 0.34 | 0.46 | 0.56 | 0.56 | 0.56 | 0.62 | 0.62 | 0.62 | 0.68 | 0.68 | 0.68 |
| (5) Inventory Stock | 0.19 | 0.17 | 0.20 | 0.24 | 0.25 | 0.25 | 0.26 | 0.26 | 0.27 | 0.28 | 0.28 | 0.29 | 0.30 | 0.31 |
| (6) Other Assets | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **II. Equity and Liabilities** | **55.05** | **57.93** | **58.38** | **67.37** | **77.42** | **76.29** | **75.13** | **73.95** | **73.72** | **73.49** | **72.83** | **72.88** | **72.77** | **72.06** |
| 1. Long Term Liabilities | 14.20 | 20.30 | 23.70 | 36.00 | 48.80 | 48.40 | 48.00 | 47.60 | 47.20 | 46.80 | 45.97 | 44.84 | 43.51 | 41.55 |
| (1) Consumer Deposits | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Long Term Foreign Loans (Existing) | 5.60 | 5.60 | 5.20 | 4.80 | 4.40 | 4.00 | 3.60 | 3.20 | 2.80 | 2.40 | 2.00 | 1.60 | 1.20 | 0.80 |
| (3) Long Term Foreign Loans (New) | 8.60 | 14.70 | 18.50 | 31.20 | 44.40 | 44.40 | 44.40 | 44.40 | 44.40 | 44.40 | 43.97 | 43.24 | 42.31 | 40.75 |
| 2. Current Liabilities | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (1) Short-term borrowing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Contractor Deposit | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3. Equity | 40.85 | 37.63 | 34.68 | 31.37 | 28.62 | 27.89 | 27.13 | 26.35 | 26.52 | 26.69 | 26.86 | 28.04 | 29.26 | 30.51 |
| (1) Equity | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 |
| (2) Equity (Donation of Existing Facilities) | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 |
| (3) Profit/Loss for the Year | -3.55 | -6.77 | -9.72 | -13.03 | -15.78 | -16.51 | -17.27 | -18.05 | -17.88 | -17.71 | -17.54 | -16.36 | -15.14 | -13.89 |
| (4) Grant in Aid (for Capital Works) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Note *1 Turnover of account receivable was assumed at 6.1
*2 Inventory Stock ws assumed as 30% of annual consumption.

## Table 127.1.23 (3/3) Balance Sheet of West Water and Sewerage Company: 2012-2038 (2/2)

(Unit: Rs. Billion)

| Item | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **I. Assets** | **71.53** | **71.31** | **71.59** | **72.94** | **74.45** | **75.93** | **74.25** | **72.50** | **70.69** | **69.92** | **69.08** | **68.20** | **68.49** |
| 1. Fixed Assets | 44.78 | 43.48 | 42.23 | 40.99 | 42.77 | 44.56 | 43.94 | 43.44 | 42.97 | 42.48 | 41.88 | 40.80 | 39.68 |
| (1) Fixed Assets | 89.72 | 91.20 | 92.71 | 94.14 | 98.50 | 102.94 | 104.70 | 106.65 | 108.71 | 110.85 | 112.96 | 114.66 | 116.38 |
| (2) Accumulated Depreciation | -44.94 | -47.73 | -50.48 | -53.15 | -55.73 | -58.38 | -60.75 | -63.21 | -65.75 | -68.37 | -71.08 | -73.86 | -76.70 |
| (3) Works in Progress | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. Current Assets | | | | | | | | | | | | | |
| (1) Cash | 3.48 | 3.65 | 3.87 | 4.21 | 4.17 | 4.12 | 3.91 | 3.72 | 3.52 | 3.41 | 3.38 | 3.40 | 3.55 |
| (2) Bank Deposit | 19.75 | 20.66 | 21.95 | 23.87 | 23.63 | 23.37 | 22.15 | 21.08 | 19.93 | 19.34 | 19.13 | 19.28 | 20.11 |
| (3) Account Receivable | 2.45 | 2.45 | 2.45 | 2.70 | 2.70 | 2.70 | 2.97 | 2.97 | 2.97 | 3.26 | 3.26 | 3.26 | 3.59 |
| (4) Allowance for Doubtful Account | 0.75 | 0.75 | 0.75 | 0.82 | 0.82 | 0.82 | 0.90 | 0.90 | 0.90 | 1.00 | 1.00 | 1.00 | 1.09 |
| (5) Inventory Stock | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 | 0.37 | 0.38 | 0.39 | 0.41 | 0.42 | 0.44 | 0.45 | 0.47 |
| (6) Other Assets | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **II. Equity and Liabilities** | **71.53** | **71.31** | **71.59** | **72.94** | **74.45** | **75.93** | **74.25** | **72.50** | **70.69** | **69.92** | **69.08** | **68.20** | **68.49** |
| 1. Long Term Liabilities | 38.93 | 36.31 | 34.09 | 31.87 | 29.65 | 27.43 | 25.21 | 22.99 | 20.77 | 18.55 | 16.33 | 14.11 | 11.89 |
| (1) Consumer Deposits | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Long Term Foreign Loans (Existing) | 0.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (3) Long Term Foreign Loans (New) | 38.53 | 36.31 | 34.09 | 31.87 | 29.65 | 27.43 | 25.21 | 22.99 | 20.77 | 18.55 | 16.33 | 14.11 | 11.89 |
| 2. Current Liabilities | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (1) Short-term borrowing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Contractor Deposit | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3. Equity | 32.60 | 35.00 | 37.50 | 41.07 | 44.80 | 48.50 | 49.04 | 49.51 | 49.92 | 51.37 | 52.75 | 54.09 | 56.60 |
| (1) Equity | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 |
| (2) Equity (Donation of Existing Facilities) | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 |
| (3) Profit/Loss for the Year | -11.80 | -9.40 | -6.90 | -3.33 | 0.40 | 4.10 | 4.64 | 5.11 | 5.52 | 6.97 | 8.35 | 9.69 | 12.20 |
| (4) Grant in Aid (for Capital Works) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## Table 127.1.24 (1/3) Profit and Loss Table of West Water and Sewerage Company (Case 1): 2012-2038 (1/2)

(Unit: Rs. Billion)

| Item | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I. Operating Revenue | **3.48** | **4.39** | **5.87** | **7.82** | **10.28** | **12.22** | **12.22** | **12.22** | **13.34** | **13.34** | **13.34** | **14.58** | **14.58** | **14.58** |
| 1. Water Sales | 1.75 | 2.40 | 3.42 | 4.83 | 6.62 | 8.03 | 8.03 | 8.03 | 8.83 | 8.83 | 8.83 | 9.71 | 9.71 | 9.71 |
| (1) Domestic | 1.29 | 1.81 | 2.65 | 3.62 | 4.91 | 5.84 | 5.84 | 5.84 | 6.42 | 6.42 | 6.42 | 7.06 | 7.06 | 7.06 |
| (2) Non-domestic | 0.47 | 0.58 | 0.77 | 1.21 | 1.71 | 2.19 | 2.19 | 2.19 | 2.41 | 2.41 | 2.41 | 2.65 | 2.65 | 2.65 |
| 2. Sewerage Service | 1.73 | 1.99 | 2.45 | 2.99 | 3.66 | 4.19 | 4.19 | 4.19 | 4.52 | 4.52 | 4.52 | 4.87 | 4.87 | 4.87 |
| (1) Domestic | 0.85 | 1.02 | 1.34 | 1.64 | 2.02 | 2.33 | 2.33 | 2.33 | 2.57 | 2.57 | 2.57 | 2.82 | 2.82 | 2.82 |
| (2) Non-domestic | 0.08 | 0.13 | 0.21 | 0.42 | 0.66 | 0.88 | 0.88 | 0.88 | 0.96 | 0.96 | 0.96 | 1.06 | 1.06 | 1.06 |
| (3) Sewage Receiving | 0.80 | 0.85 | 0.89 | 0.94 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |
| II. Operating Expenses | **5.30** | **5.70** | **6.39** | **7.51** | **8.03** | **9.02** | **9.10** | **9.18** | **9.26** | **9.34** | **9.43** | **9.14** | **9.24** | **9.34** |
| 1. Operation Costs | 4.24 | 4.56 | 5.11 | 6.01 | 6.42 | 7.21 | 7.28 | 7.34 | 7.41 | 7.47 | 7.54 | 7.31 | 7.39 | 7.47 |
| (1) Water Supply | 4.14 | 4.46 | 4.68 | 5.04 | 5.43 | 6.22 | 6.27 | 6.32 | 6.37 | 6.42 | 6.48 | 6.23 | 6.29 | 6.36 |
| 1) Electricity | 0.46 | 0.55 | 0.57 | 0.60 | 0.62 | 0.65 | 0.68 | 0.71 | 0.74 | 0.78 | 0.81 | 0.85 | 0.88 | 0.92 |
| 2) Compensation | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| 3) Water Source Cost | 1.23 | 1.28 | 1.32 | 1.37 | 1.42 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 |
| 4) Depreciation | 1.82 | 2.06 | 2.19 | 2.47 | 2.76 | 2.57 | 2.58 | 2.58 | 2.59 | 2.60 | 2.60 | 2.31 | 2.32 | 2.33 |
| 5) Others | 0.60 | 0.55 | 0.57 | 0.58 | 0.59 | 0.60 | 0.61 | 0.62 | 0.63 | 0.65 | 0.66 | 0.67 | 0.69 | 0.70 |
| (2) Sewerage | 0.10 | 0.10 | 0.43 | 0.97 | 0.99 | 0.99 | 1.02 | 1.03 | 1.04 | 1.05 | 1.07 | 1.08 | 1.10 | 1.11 |
| 1) Electricity | 0.00 | 0.00 | 0.02 | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.06 | 0.06 | 0.06 |
| 2) Compensation | 0.00 | 0.00 | 0.01 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 |
| 3) Depreciation | 0.07 | 0.07 | 0.31 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 |
| 4) Others | 0.03 | 0.03 | 0.10 | 0.21 | 0.23 | 0.23 | 0.25 | 0.25 | 0.26 | 0.27 | 0.28 | 0.29 | 0.30 | 0.32 |
| 2. Others | 1.06 | 1.14 | 1.28 | 1.50 | 1.61 | 1.80 | 1.82 | 1.84 | 1.85 | 1.87 | 1.89 | 1.83 | 1.85 | 1.87 |
| III. Net Operating Revenue/Deficit | **-1.82** | **-1.31** | **-0.52** | **0.31** | **2.25** | **3.20** | **3.12** | **3.04** | **4.09** | **4.00** | **3.91** | **5.44** | **5.34** | **5.24** |
| IV. Non-operating Profit/Loss | -0.56 | -0.43 | -0.74 | -1.34 | -2.08 | -2.11 | -2.02 | -1.92 | -1.87 | -1.75 | -1.63 | -1.56 | -1.41 | -1.25 |
| 1. Non-operating Income | 0.00 | 0.41 | 0.32 | 0.43 | 0.37 | 0.34 | 0.43 | 0.53 | 0.64 | 0.75 | 0.88 | 0.99 | 1.11 | 1.23 |
| (1) Interest Revenue | 0.00 | 0.41 | 0.32 | 0.43 | 0.37 | 0.34 | 0.43 | 0.53 | 0.64 | 0.75 | 0.88 | 0.99 | 1.11 | 1.23 |
| (2) Other Revenues | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. Non-operating Expenses | 0.56 | 0.85 | 1.06 | 1.77 | 2.45 | 2.45 | 2.45 | 2.45 | 2.51 | 2.51 | 2.51 | 2.55 | 2.52 | 2.48 |
| (1) Long-term Interest (New Loans) | 0.43 | 0.67 | 0.81 | 1.42 | 1.99 | 1.89 | 1.89 | 1.89 | 1.89 | 1.89 | 1.89 | 1.87 | 1.84 | 1.80 |
| (2) Short-term Interest | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (3) Bad Debt Expense | 0.13 | 0.18 | 0.25 | 0.34 | 0.46 | 0.56 | 0.56 | 0.56 | 0.62 | 0.62 | 0.62 | 0.68 | 0.68 | 0.68 |
| V. Ordinary Profit/Loss | -2.38 | -1.74 | -1.26 | -1.02 | 0.17 | 1.10 | 1.10 | 1.13 | 2.22 | 2.25 | 2.29 | 3.88 | 3.93 | 3.99 |
| VI. Profit Tax | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.38 | 0.39 | 0.39 | 0.78 | 0.79 | 0.80 | 1.36 | 1.38 | 1.40 |
| VII. Profit after Tax | -2.38 | -1.74 | -1.26 | -1.02 | 0.11 | 0.71 | 0.72 | 0.73 | 1.44 | 1.46 | 1.49 | 2.52 | 2.56 | 2.59 |
| VIII. Stock Dividend | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| IX Net Profit/Deficit | **-2.38** | **-1.74** | **-1.26** | **-1.02** | **0.11** | **0.71** | **0.72** | **0.73** | **1.44** | **1.46** | **1.49** | **2.52** | **2.56** | **2.59** |
| 1. Balance for Previous Years at Beginning of the Year | 0.00 | -2.38 | -4.13 | -5.38 | -6.41 | -6.30 | -5.58 | -4.86 | -4.13 | -2.69 | -1.23 | 0.26 | 2.78 | 5.33 |
| 2. Balance of Accumulated Profit/Deficit at End of the ` | **-2.38** | **-4.13** | **-5.38** | **-6.41** | **-6.30** | **-5.58** | **-4.86** | **-4.13** | **-2.69** | **-1.23** | **0.26** | **2.78** | **5.33** | **7.93** |

Note: 1. Overhead ratio (including taxes) 10% of Water and Sewerage Costs <== including taxes and duties
2. Ratio of bad account receivable 5% of Water Supply and Sewerage Service
3. Corporate Tax 35% of Profit of the Year

## Table 127.1.24 (1/3) Profit and Loss Table of West Water and Sewerage Company (Case 1): 2012-2038 (2/2)

(Unit: Rs. Billion)

| Item | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I. Operating Revenue | **15.94** | **15.94** | **15.94** | **17.44** | **17.44** | **17.44** | **19.08** | **19.08** | **19.08** | **20.89** | **20.89** | **20.89** | **22.88** |
| 1. Water Sales | 10.68 | 10.68 | 10.68 | 11.75 | 11.75 | 11.75 | 12.93 | 12.93 | 12.93 | 14.22 | 14.22 | 14.22 | 15.64 |
| (1) Domestic | 7.77 | 7.77 | 7.77 | 8.54 | 8.54 | 8.54 | 9.40 | 9.40 | 9.40 | 10.34 | 10.34 | 10.34 | 11.37 |
| (2) Non-domestic | 2.92 | 2.92 | 2.92 | 3.21 | 3.21 | 3.21 | 3.53 | 3.53 | 3.53 | 3.88 | 3.88 | 3.88 | 4.27 |
| 2. Sewerage Service | 5.26 | 5.26 | 5.26 | 5.68 | 5.68 | 5.68 | 6.15 | 6.15 | 6.15 | 6.67 | 6.67 | 6.67 | 7.24 |
| (1) Domestic | 3.11 | 3.11 | 3.11 | 3.42 | 3.42 | 3.42 | 3.76 | 3.76 | 3.76 | 4.14 | 4.14 | 4.14 | 4.55 |
| (2) Non-domestic | 1.17 | 1.17 | 1.17 | 1.28 | 1.28 | 1.28 | 1.41 | 1.41 | 1.41 | 1.55 | 1.55 | 1.55 | 1.71 |
| (3) Sewage Receiving | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |
| II. Operating Expenses | **9.53** | **9.26** | **9.32** | **9.33** | **9.48** | **9.84** | **9.63** | **9.86** | **10.11** | **10.36** | **10.63** | **10.88** | **11.14** |
| 1. Operation Costs | 7.63 | 7.40 | 7.46 | 7.46 | 7.58 | 7.87 | 7.70 | 7.89 | 8.08 | 8.29 | 8.50 | 8.70 | 8.91 |
| (1) Water Supply | 6.50 | 6.28 | 6.31 | 6.39 | 6.53 | 6.67 | 6.52 | 6.68 | 6.85 | 7.03 | 7.21 | 7.38 | 7.56 |
| 1) Electricity | 0.96 | 1.01 | 1.05 | 1.10 | 1.15 | 1.20 | 1.25 | 1.31 | 1.37 | 1.43 | 1.49 | 1.56 | 1.63 |
| 2) Compensation | 0.05 | 0.05 | 0.05 | 0.05 | 0.06 | 0.06 | 0.06 | 0.06 | 0.07 | 0.07 | 0.07 | 0.07 | 0.08 |
| 3) Water Source Cost | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 |
| 4) Depreciation | 2.40 | 2.12 | 2.09 | 2.10 | 2.16 | 2.23 | 2.00 | 2.08 | 2.16 | 2.25 | 2.33 | 2.40 | 2.47 |
| 5) Others | 0.72 | 0.74 | 0.75 | 0.77 | 0.79 | 0.82 | 0.84 | 0.87 | 0.89 | 0.92 | 0.95 | 0.99 | 1.02 |
| (2) Sewerage | 1.13 | 1.13 | 1.15 | 1.08 | 1.06 | 1.20 | 1.18 | 1.21 | 1.23 | 1.26 | 1.29 | 1.32 | 1.35 |
| 1) Electricity | 0.06 | 0.07 | 0.07 | 0.07 | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.09 | 0.10 | 0.10 | 0.11 |
| 2) Compensation | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.06 | 0.06 | 0.06 | 0.06 | 0.07 | 0.07 | 0.07 |
| 3) Depreciation | 0.69 | 0.67 | 0.68 | 0.58 | 0.54 | 0.66 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 |
| 4) Others | 0.33 | 0.34 | 0.36 | 0.37 | 0.39 | 0.40 | 0.42 | 0.44 | 0.46 | 0.48 | 0.50 | 0.52 | 0.55 |
| 2. Others | 1.91 | 1.85 | 1.86 | 1.87 | 1.90 | 1.97 | 1.93 | 1.97 | 2.02 | 2.07 | 2.13 | 2.18 | 2.23 |
| III. Net Operating Revenue/Deficit | **6.41** | **6.69** | **6.62** | **8.11** | **7.96** | **7.60** | **9.46** | **9.22** | **8.98** | **10.53** | **10.26** | **10.01** | **11.74** |
| IV. Non-operating Profit/Loss | -1.15 | -1.01 | -0.84 | -0.74 | -0.67 | -0.68 | -0.78 | -0.70 | -0.62 | -0.63 | -0.54 | -0.43 | -0.41 |
| 1. Non-operating Income | 1.33 | 1.38 | 1.45 | 1.53 | 1.50 | 1.40 | 1.29 | 1.27 | 1.26 | 1.24 | 1.25 | 1.26 | 1.29 |
| (1) Interest Revenue | 1.33 | 1.38 | 1.45 | 1.53 | 1.50 | 1.40 | 1.29 | 1.27 | 1.26 | 1.24 | 1.25 | 1.26 | 1.29 |
| (2) Other Revenues | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. Non-operating Expenses | 2.48 | 2.39 | 2.29 | 2.27 | 2.18 | 2.08 | 2.07 | 1.98 | 1.88 | 1.88 | 1.78 | 1.69 | 1.69 |
| (1) Long-term Interest (New Loans) | 1.73 | 1.64 | 1.54 | 1.45 | 1.35 | 1.26 | 1.17 | 1.07 | 0.98 | 0.88 | 0.79 | 0.69 | 0.60 |
| (2) Short-term Interest | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (3) Bad Debt Expense | 0.75 | 0.75 | 0.75 | 0.82 | 0.82 | 0.82 | 0.90 | 0.90 | 0.90 | 1.00 | 1.00 | 1.00 | 1.09 |
| V. Ordinary Profit/Loss | 5.26 | 5.68 | 5.78 | 7.37 | 7.28 | 6.92 | 8.67 | 8.52 | 8.35 | 9.90 | 9.73 | 9.59 | 11.34 |
| VI. Profit Tax | 1.84 | 1.99 | 2.02 | 2.58 | 2.55 | 2.42 | 3.04 | 2.98 | 2.92 | 3.46 | 3.40 | 3.36 | 3.97 |
| VII. Profit after Tax | 3.42 | 3.69 | 3.75 | 4.79 | 4.73 | 4.49 | 5.64 | 5.54 | 5.43 | 6.43 | 6.32 | 6.23 | 7.37 |
| VIII Stock Dividend | 0.00 | 0.00 | 0.00 | 4.44 | 4.44 | 4.44 | 4.44 | 4.44 | 4.44 | 4.44 | 4.44 | 4.44 | 4.44 |
| IX Net Profit/Deficit | **3.42** | **3.69** | **3.75** | **0.35** | **0.29** | **0.05** | **1.20** | **1.10** | **0.99** | **1.99** | **1.88** | **1.79** | **2.93** |
| 1. Balance for Previous Years at Beginning of the Year | 7.93 | 11.34 | 15.03 | 18.79 | 19.14 | 19.44 | 19.49 | 20.69 | 21.79 | 22.78 | 24.77 | 26.65 | 28.44 |
| 2. Balance of Accumulated Profit/Deficit at End of the Year | **11.34** | **15.03** | **18.79** | **19.14** | **19.44** | **19.49** | **20.69** | **21.79** | **22.78** | **24.77** | **26.65** | **28.44** | **31.37** |

## Table 127.1.24 (2/3) Cash Flow Table of West Water and Sewerage Company (Case 1): 2012-2038 (1/2)

(Unit: Rs. Billion)

| Item | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **I. Procurement** | | | | | | | | | | | | | | |
| 1. Operating Revenue | 2.68 | 3.54 | 4.98 | 6.89 | 9.30 | 11.24 | 11.24 | 11.24 | 12.36 | 12.36 | 12.36 | 13.60 | 13.60 | 13.60 |
| 2. Sewage Receiving | 0.80 | 0.85 | 0.89 | 0.94 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |
| 3. Depreciation | 1.88 | 2.13 | 2.49 | 3.17 | 3.46 | 3.26 | 3.27 | 3.28 | 3.28 | 3.29 | 3.30 | 3.00 | 3.01 | 3.02 |
| 4. Account Receivable*1 | -0.44 | -0.14 | -0.24 | -0.31 | -0.39 | -0.32 | 0.00 | 0.00 | -0.18 | 0.00 | 0.00 | -0.20 | 0.00 | 0.00 |
| 5. Interest Revenue from Saving | 0.00 | 0.41 | 0.32 | 0.43 | 0.37 | 0.34 | 0.43 | 0.53 | 0.64 | 0.75 | 0.88 | 0.99 | 1.11 | 1.23 |
| Gross Internal Cash Position | 4.92 | 6.79 | 8.45 | 11.11 | 13.71 | 15.51 | 15.92 | 16.03 | 17.08 | 17.39 | 17.52 | 18.37 | 18.70 | 18.83 |
| 1. Capital Infusion | 14.00 | | | | | | | | | | | | | |
| 2. Existing Facilities Taken Over | 12.15 | | | | | | | | | | | | | |
| 3. Donation of Existing Facilities | 18.25 | | | | | | | | | | | | | |
| 4. Foreign Loan (Existing) | 6.00 | | | | | | | | | | | | | |
| 5. Foreign Loan (New Loans) | 8.60 | 6.10 | 3.80 | 12.70 | 13.20 | | | | | | | | | |
| 6. Government Assistance | 0.00 | | | | | | | | | | | | | |
| 7. Short-term Borrowing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | | | | |
| Total Sources | 63.92 | 12.89 | 12.25 | 23.81 | 26.91 | 15.51 | 15.92 | 16.03 | 17.08 | 17.39 | 17.52 | 18.37 | 18.70 | 18.83 |
| **II. Disbursement** | | | | | | | | | | | | | | |
| 1. Investment | 41.15 | | | | | | | | | | | | | |
| (1) Existing Facilities Taken Over | 12.15 | | | | | | | | | | | | | |
| (2) Donation from KW&SB | 18.25 | | | | | | | | | | | | | |
| (3) Water Supply Facilities | 8.43 | 5.81 | 3.06 | 6.65 | 6.85 | | | | | | | | | |
| (4) Sewerage Facilities | 2.32 | 1.77 | 1.72 | 9.28 | 9.68 | | | | | | | | | |
| (5) Replacement of Water Supply | | | | | | 0.16 | 0.16 | 0.16 | 0.17 | 0.17 | 0.17 | 0.17 | 0.21 | 0.22 |
| (6) Replacement of Sewerage | | | | | | | | | | | | | | |
| 2. Debt Services | 1.13 | 1.31 | 1.44 | 2.03 | 2.57 | 2.46 | 2.44 | 2.42 | 2.41 | 2.39 | 2.80 | 3.07 | 3.21 | 3.79 |
| (1) Principal Repayment (Transferred) | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| (2) Principal Repayment (New Loans) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.43 | 0.74 | 0.93 | 1.56 |
| (3) Financial Charges (Transferred) | 0.30 | 0.24 | 0.22 | 0.20 | 0.19 | 0.17 | 0.15 | 0.14 | 0.12 | 0.10 | 0.09 | 0.07 | 0.05 | 0.03 |
| (4) Financial Charges (New Loans) | 0.43 | 0.67 | 0.81 | 1.42 | 1.99 | 1.89 | 1.89 | 1.89 | 1.89 | 1.89 | 1.89 | 1.87 | 1.84 | 1.80 |
| 3. Debt Services for Short Financing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (1) Principal Repayment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Financial Charges | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 4. Deferred Assets | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5. Inventory Stock*2 | 0.19 | 0.17 | 0.20 | 0.24 | 0.25 | 0.25 | 0.26 | 0.26 | 0.27 | 0.28 | 0.28 | 0.29 | 0.30 | 0.31 |
| 6. Other Disbursement | 3.41 | 3.57 | 3.89 | 4.35 | 4.57 | 5.75 | 5.83 | 5.90 | 5.97 | 6.05 | 6.13 | 6.14 | 6.23 | 6.32 |
| 7. Profit Tax | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.38 | 0.39 | 0.39 | 0.78 | 0.79 | 0.80 | 1.36 | 1.38 | 1.40 |
| Total Disbursement | 46.88 | 5.05 | 5.53 | 6.61 | 7.45 | 8.84 | 8.91 | 8.98 | 9.43 | 9.50 | 10.02 | 10.86 | 11.12 | 11.82 |
| **III. Net Cash Flow** | **17.04** | **7.83** | **6.73** | **17.20** | **19.46** | **6.67** | **7.01** | **7.05** | **7.65** | **7.88** | **7.50** | **7.51** | **7.58** | **7.01** |
| **IV. Opening Cash Balance** | 0.00 | 17.04 | 24.87 | 31.60 | 48.80 | 68.26 | 74.93 | 81.94 | 88.99 | 96.64 | 104.53 | 112.03 | 119.54 | 127.12 |
| **V. Accumulated Cash Position** | **17.04** | **24.87** | **31.60** | **48.80** | **68.26** | **74.93** | **81.94** | **88.99** | **96.64** | **104.53** | **112.03** | **119.54** | **127.12** | **134.13** |

Note: *1 Turnover of account receivable was assumed at 6.1
*2 Inventory Stock ws assumed as 30% of annual consumption.

## Table 127.1.24 (2/3) Cash Flow Table of West Water and Sewerage Company (Case 1): 2012-2038 (2/2)

(Unit: Rs. Billion)

| Item | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **I. Procurement** | | | | | | | | | | | | | |
| 1. Operating Revenue | 14.96 | 14.96 | 14.96 | 16.45 | 16.45 | 16.45 | 18.10 | 18.10 | 18.10 | 19.91 | 19.91 | 19.91 | 21.90 |
| 2. Sewage Receiving | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |
| 3. Depreciation | 3.10 | 2.79 | 2.77 | 2.68 | 2.71 | 2.90 | 2.62 | 2.70 | 2.79 | 2.87 | 2.96 | 3.02 | 3.09 |
| 4. Account Receivable*1 | -0.22 | 0.00 | 0.00 | -0.25 | 0.00 | 0.00 | -0.27 | 0.00 | 0.00 | -0.30 | 0.00 | 0.00 | -0.33 |
| 5. Interest Revenue from Saving | 1.33 | 1.38 | 1.45 | 1.53 | 1.50 | 1.40 | 1.29 | 1.27 | 1.26 | 1.24 | 1.25 | 1.26 | 1.29 |
| Gross Internal Cash Position | 20.14 | 20.11 | 20.16 | 21.40 | 21.65 | 21.73 | 22.72 | 23.06 | 23.13 | 24.71 | 25.10 | 25.18 | 26.94 |
| 1. Capital Infusion | | | | | | | | | | | | | |
| 2. Existing Facilities Taken Over | | | | | | | | | | | | | |
| 3. Donation of Existing Facilities | | | | | | | | | | | | | |
| 4. Foreign Loan (Existing) | | | | | | | | | | | | | |
| 5. Foreign Loan (New Loans) | | | | | | | | | | | | | |
| 6. Government Assistance | | | | | | | | | | | | | |
| 7. Short-term Borrowing | | | | | | | | | | | | | |
| Total Sources | 20.14 | 20.11 | 20.16 | 21.40 | 21.65 | 21.73 | 22.72 | 23.06 | 23.13 | 24.71 | 25.10 | 25.18 | 26.94 |
| **II. Disbursement** | | | | | | | | | | | | | |
| 1. Investment | | | | | | | | | | | | | |
| (1) Existing Facilities Taken Over | | | | | | | | | | | | | |
| (2) Donation from KW&SB | | | | | | | | | | | | | |
| (3) Water Supply Facilities | | | | | | | | | | | | | |
| (4) Sewerage Facilities | | | | | | | | | | | | | |
| (5) Replacement of Water Supply | 1.85 | 1.36 | 1.38 | 1.42 | 1.54 | 1.58 | 1.76 | 1.95 | 2.07 | 2.14 | 2.11 | 1.70 | 1.72 |
| (6) Replacement of Sewerage | | 0.12 | 0.12 | 0.01 | 2.81 | 2.86 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. Debt Services | 4.37 | 3.86 | 3.76 | 3.67 | 3.57 | 3.48 | 3.39 | 3.29 | 3.20 | 3.10 | 3.01 | 2.91 | 2.82 |
| (1) Principal Repayment (Transferred) | 0.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Principal Repayment (New Loans) | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 |
| (3) Financial Charges (Transferred) | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (4) Financial Charges (New Loans) | 1.73 | 1.64 | 1.54 | 1.45 | 1.35 | 1.26 | 1.17 | 1.07 | 0.98 | 0.88 | 0.79 | 0.69 | 0.60 |
| 3. Debt Services for Short Financing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (1) Principal Repayment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Financial Charges | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 4. Deferred Assets | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5. Inventory Stock*2 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 | 0.37 | 0.38 | 0.39 | 0.41 | 0.42 | 0.44 | 0.45 | 0.47 |
| 6. Other Disbursement | 6.44 | 6.46 | 6.56 | 6.65 | 6.77 | 6.94 | 7.00 | 7.16 | 7.32 | 7.49 | 7.67 | 7.85 | 8.05 |
| 7. Profit Tax | 1.84 | 1.99 | 2.02 | 2.58 | 2.55 | 2.42 | 3.04 | 2.98 | 2.92 | 3.46 | 3.40 | 3.36 | 3.97 |
| Total Disbursement | 12.96 | 12.63 | 12.68 | 13.24 | 13.25 | 13.21 | 13.80 | 13.82 | 13.85 | 14.48 | 14.52 | 14.58 | 15.31 |
| **III. Net Cash Flow** | **7.18** | **7.48** | **7.48** | **8.16** | **8.40** | **8.52** | **8.92** | **9.23** | **9.28** | **10.23** | **10.58** | **10.60** | **11.63** |
| **IV. Opening Cash Balance** | 134.13 | 141.31 | 148.80 | 156.28 | 164.44 | 172.84 | 181.36 | 190.28 | 199.52 | 208.80 | 219.03 | 229.60 | 240.21 |
| **V. Accumulated Cash Position** | **141.31** | **148.80** | **156.28** | **164.44** | **172.84** | **181.36** | **190.28** | **199.52** | **208.80** | **219.03** | **229.60** | **240.21** | **251.84** |

## Table 127.1.24 (3/3) Balance Sheet of West Water and Sewerage Company (Case 1): 2012-2038 (1/2)

(Unit: Rs. Billion)

| Item | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **I. Assets** | **56.22** | **60.57** | **62.72** | **74.00** | **86.91** | **87.22** | **87.54** | **87.87** | **88.91** | **89.97** | **90.63** | **92.02** | **93.25** | **93.88** |
| 1. Fixed Assets | 41.58 | 48.80 | 47.00 | 59.92 | 73.15 | 70.05 | 66.94 | 63.82 | 60.71 | 57.58 | 54.46 | 51.63 | 48.83 | 46.03 |
| (1) Fixed Assets | 41.15 | 48.73 | 53.50 | 69.59 | 86.28 | 86.44 | 86.60 | 86.76 | 86.93 | 87.10 | 87.27 | 87.44 | 87.65 | 87.87 |
| (2) Accumulated Depreciation | -1.88 | -4.01 | -6.50 | -9.67 | -13.13 | -16.39 | -19.66 | -22.94 | -26.22 | -29.51 | -32.81 | -35.81 | -38.82 | -41.84 |
| (3) Works in Progress | 2.32 | 4.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. Current Assets | 14.64 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (1) Cash | 2.08 | 1.63 | 2.17 | 1.85 | 1.73 | 2.18 | 2.69 | 3.21 | 3.79 | 4.42 | 4.99 | 5.58 | 6.18 | 6.69 |
| (2) Bank Deposit | 11.79 | 9.21 | 12.29 | 10.51 | 9.79 | 12.34 | 15.25 | 18.17 | 21.50 | 25.05 | 28.26 | 31.61 | 35.03 | 37.94 |
| (3) Account Receivable | 0.44 | 0.58 | 0.82 | 1.13 | 1.52 | 1.84 | 1.84 | 1.84 | 2.03 | 2.03 | 2.03 | 2.23 | 2.23 | 2.23 |
| (4) Allowance for Doubtful Account | 0.13 | 0.18 | 0.25 | 0.34 | 0.46 | 0.56 | 0.56 | 0.56 | 0.62 | 0.62 | 0.62 | 0.68 | 0.68 | 0.68 |
| (5) Inventory Stock | 0.19 | 0.17 | 0.20 | 0.24 | 0.25 | 0.25 | 0.26 | 0.26 | 0.27 | 0.28 | 0.28 | 0.29 | 0.30 | 0.31 |
| (6) Other Assets | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **II. Equity and Liabilities** | **56.22** | **60.57** | **62.72** | **74.00** | **86.91** | **87.22** | **87.54** | **87.87** | **88.91** | **89.97** | **90.63** | **92.02** | **93.25** | **93.88** |
| 1. Long Term Liabilities | 14.20 | 20.30 | 23.70 | 36.00 | 48.80 | 48.40 | 48.00 | 47.60 | 47.20 | 46.80 | 45.97 | 44.84 | 43.51 | 41.55 |
| (1) Consumer Deposits | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Long Term Foreign Loans (Existing) | 5.60 | 5.60 | 5.20 | 4.80 | 4.40 | 4.00 | 3.60 | 3.20 | 2.80 | 2.40 | 2.00 | 1.60 | 1.20 | 0.80 |
| (3) Long Term Foreign Loans (New) | 8.60 | 14.70 | 18.50 | 31.20 | 44.40 | 44.40 | 44.40 | 44.40 | 44.40 | 44.40 | 43.97 | 43.24 | 42.31 | 40.75 |
| 2. Current Liabilities | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (1) Short-term borrowing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Contractor Deposit | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3. Equity | 42.02 | 40.27 | 39.02 | 38.00 | 38.11 | 38.82 | 39.54 | 40.27 | 41.71 | 43.17 | 44.66 | 47.18 | 49.74 | 52.33 |
| (1) Equity | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 |
| (2) Equity (Donation of Existing Facilities) | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 |
| (3) Profit/Loss for the Year | -2.38 | -4.13 | -5.38 | -6.41 | -6.30 | -5.58 | -4.86 | -4.13 | -2.69 | -1.23 | 0.26 | 2.78 | 5.33 | 7.93 |
| (4) Grant in Aid (for Capital Works) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Note *1 Turnover of account receivable was assumed at 6.1

*2 Inventory Stock ws assumed as 30% of annual consumption.

## Table 127.1.24 (3/3) Balance Sheet of West Water and Sewerage Company (Case 1): 2012-2038 (2/2)

(Unit: Rs. Billion)

| Item | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **I. Assets** | **94.67** | **95.75** | **97.28** | **95.41** | **93.49** | **91.32** | **90.30** | **89.18** | **87.95** | **87.72** | **87.38** | **86.95** | **87.66** |
| 1. Fixed Assets | 44.78 | 43.47 | 42.21 | 40.97 | 42.61 | 44.16 | 43.29 | 42.54 | 41.82 | 41.09 | 40.24 | 38.92 | 37.55 |
| (1) Fixed Assets | 89.72 | 91.20 | 92.71 | 94.14 | 98.50 | 102.94 | 104.70 | 106.65 | 108.71 | 110.85 | 112.96 | 114.66 | 116.38 |
| (2) Accumulated Depreciation | -44.94 | -47.73 | -50.50 | -53.18 | -55.88 | -58.78 | -61.40 | -64.10 | -66.89 | -69.76 | -72.72 | -75.74 | -78.83 |
| (3) Works in Progress | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. Current Assets | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (1) Cash | 6.96 | 7.31 | 7.73 | 7.59 | 7.05 | 6.49 | 6.41 | 6.36 | 6.28 | 6.29 | 6.37 | 6.50 | 6.74 |
| (2) Bank Deposit | 39.42 | 41.44 | 43.80 | 43.00 | 39.95 | 36.79 | 36.34 | 36.01 | 35.57 | 35.66 | 36.08 | 36.83 | 38.22 |
| (3) Account Receivable | 2.45 | 2.45 | 2.45 | 2.70 | 2.70 | 2.70 | 2.97 | 2.97 | 2.97 | 3.26 | 3.26 | 3.26 | 3.59 |
| (4) Allowance for Doubtful Account | 0.75 | 0.75 | 0.75 | 0.82 | 0.82 | 0.82 | 0.90 | 0.90 | 0.90 | 1.00 | 1.00 | 1.00 | 1.09 |
| (5) Inventory Stock | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 | 0.37 | 0.38 | 0.39 | 0.41 | 0.42 | 0.44 | 0.45 | 0.47 |
| (6) Other Assets | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **II. Equity and Liabilities** | **94.67** | **95.75** | **97.28** | **95.41** | **93.49** | **91.32** | **90.30** | **89.18** | **87.95** | **87.72** | **87.38** | **86.95** | **87.66** |
| 1. Long Term Liabilities | 38.93 | 36.31 | 34.09 | 31.87 | 29.65 | 27.43 | 25.21 | 22.99 | 20.77 | 18.55 | 16.33 | 14.11 | 11.89 |
| (1) Consumer Deposits | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Long Term Foreign Loans (Existing) | 0.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (3) Long Term Foreign Loans (New) | 38.53 | 36.31 | 34.09 | 31.87 | 29.65 | 27.43 | 25.21 | 22.99 | 20.77 | 18.55 | 16.33 | 14.11 | 11.89 |
| 2. Current Liabilities | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (1) Short-term borrowing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Contractor Deposit | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3. Equity | 55.74 | 59.44 | 63.19 | 63.54 | 63.84 | 63.89 | 65.09 | 66.19 | 67.18 | 69.17 | 71.05 | 72.84 | 75.77 |
| (1) Equity | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 |
| (2) Equity (Donation of Existing Facilities) | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 |
| (3) Profit/Loss for the Year | 11.34 | 15.03 | 18.79 | 19.14 | 19.44 | 19.49 | 20.69 | 21.79 | 22.78 | 24.77 | 26.65 | 28.44 | 31.37 |
| (4) Grant in Aid (for Capital Works) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## Table A127.1.25 (1/3) Profit and Loss Table of West Water and Sewerage Company (Case 2): 2012-2038 (1/2)

(Unit: Rs. Billion)

| Item | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I. Operating Revenue | **3.56** | **4.51** | **6.26** | **8.42** | **11.13** | **13.82** | **13.82** | **13.82** | **15.75** | **15.75** | **15.75** | **17.97** | **17.97** | **17.97** |
| 1. Water Sales | 1.79 | 2.47 | 3.67 | 5.24 | 7.22 | 9.17 | 9.17 | 9.17 | 10.55 | 10.55 | 10.55 | 12.13 | 12.13 | 12.13 |
| (1) Domestic | 1.31 | 1.87 | 2.85 | 3.93 | 5.36 | 6.67 | 6.67 | 6.67 | 7.67 | 7.67 | 7.67 | 8.82 | 8.82 | 8.82 |
| (2) Non-domestic | 0.47 | 0.60 | 0.82 | 1.30 | 1.87 | 2.50 | 2.50 | 2.50 | 2.88 | 2.88 | 2.88 | 3.31 | 3.31 | 3.31 |
| 2. Sewerage Service | 1.77 | 2.05 | 2.59 | 3.18 | 3.91 | 4.65 | 4.65 | 4.65 | 5.20 | 5.20 | 5.20 | 5.84 | 5.84 | 5.84 |
| (1) Domestic | 0.89 | 1.06 | 1.47 | 1.79 | 2.20 | 2.67 | 2.67 | 2.67 | 3.07 | 3.07 | 3.07 | 3.53 | 3.53 | 3.53 |
| (2) Non-domestic | 0.08 | 0.14 | 0.23 | 0.46 | 0.72 | 1.00 | 1.00 | 1.00 | 1.15 | 1.15 | 1.15 | 1.32 | 1.32 | 1.32 |
| (3) Sewage Receiving | 0.80 | 0.85 | 0.89 | 0.94 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |
| II. Operating Expenses | 5.30 | 5.70 | 6.39 | 7.51 | 8.03 | 9.02 | 9.10 | 9.18 | 9.26 | 9.34 | 9.43 | 9.14 | 9.24 | 9.34 |
| 1. Operation Costs | 4.24 | 4.56 | 5.11 | 6.01 | 6.42 | 7.21 | 7.28 | 7.34 | 7.41 | 7.47 | 7.54 | 7.31 | 7.39 | 7.47 |
| (1) Water Supply | 4.14 | 4.46 | 4.68 | 5.04 | 5.43 | 6.22 | 6.27 | 6.32 | 6.37 | 6.42 | 6.48 | 6.23 | 6.29 | 6.36 |
| 1) Electricity | 0.46 | 0.55 | 0.57 | 0.60 | 0.62 | 0.65 | 0.68 | 0.71 | 0.74 | 0.78 | 0.81 | 0.85 | 0.88 | 0.92 |
| 2) Compensation | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| 3) Water Source Cost | 1.23 | 1.28 | 1.32 | 1.37 | 1.42 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 |
| 4) Depreciation | 1.82 | 2.06 | 2.19 | 2.47 | 2.76 | 2.57 | 2.58 | 2.58 | 2.59 | 2.60 | 2.60 | 2.31 | 2.32 | 2.33 |
| 5) Others | 0.60 | 0.55 | 0.57 | 0.58 | 0.59 | 0.60 | 0.61 | 0.62 | 0.63 | 0.65 | 0.66 | 0.67 | 0.69 | 0.70 |
| (2) Sewerage | 0.10 | 0.10 | 0.43 | 0.97 | 0.99 | 0.99 | 1.02 | 1.03 | 1.04 | 1.05 | 1.07 | 1.08 | 1.10 | 1.11 |
| 1) Electricity | 0.00 | 0.00 | 0.02 | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.06 | 0.06 | 0.06 |
| 2) Compensation | 0.00 | 0.00 | 0.01 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 |
| 3) Depreciation | 0.07 | 0.07 | 0.31 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 |
| 4) Others | 0.03 | 0.03 | 0.10 | 0.21 | 0.23 | 0.23 | 0.25 | 0.25 | 0.26 | 0.27 | 0.28 | 0.29 | 0.30 | 0.32 |
| 2. Others | 1.06 | 1.14 | 1.28 | 1.50 | 1.61 | 1.80 | 1.82 | 1.84 | 1.85 | 1.87 | 1.89 | 1.83 | 1.85 | 1.87 |
| III. Net Operating Revenue/Deficit | **-1.74** | **-1.19** | **-0.12** | **0.91** | **3.10** | **4.81** | **4.72** | **4.65** | **6.49** | **6.41** | **6.32** | **8.82** | **8.73** | **8.62** |
| IV. Non-operating Profit/Loss | -0.57 | -0.44 | -0.76 | -1.35 | -2.09 | -2.14 | -2.03 | -1.89 | -1.86 | -1.70 | -1.53 | -1.46 | -1.38 | -1.29 |
| 1. Non-operating Income | 0.00 | 0.41 | 0.33 | 0.44 | 0.40 | 0.39 | 0.50 | 0.63 | 0.77 | 0.93 | 1.10 | 1.26 | 1.31 | 1.36 |
| (1) Interest Revenue | 0.00 | 0.41 | 0.33 | 0.44 | 0.40 | 0.39 | 0.50 | 0.63 | 0.77 | 0.93 | 1.10 | 1.26 | 1.31 | 1.36 |
| (2) Other Revenues | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. Non-operating Expenses | 0.57 | 0.85 | 1.08 | 1.80 | 2.49 | 2.53 | 2.53 | 2.53 | 2.63 | 2.63 | 2.63 | 2.72 | 2.69 | 2.65 |
| (1) Long-term Interest (New Loans) | 0.43 | 0.67 | 0.81 | 1.42 | 1.99 | 1.89 | 1.89 | 1.89 | 1.89 | 1.89 | 1.89 | 1.87 | 1.84 | 1.80 |
| (2) Short-term Interest | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (3) Bad Debt Expense | 0.14 | 0.18 | 0.27 | 0.37 | 0.51 | 0.64 | 0.64 | 0.64 | 0.74 | 0.74 | 0.74 | 0.85 | 0.85 | 0.85 |
| V. Ordinary Profit/Loss | -2.31 | -1.63 | -0.88 | -0.44 | 1.01 | 2.67 | 2.70 | 2.75 | 4.64 | 4.71 | 4.79 | 7.37 | 7.35 | 7.34 |
| VI. Profit Tax | 0.00 | 0.00 | 0.00 | 0.00 | 0.35 | 0.93 | 0.94 | 0.96 | 1.62 | 1.65 | 1.68 | 2.58 | 2.57 | 2.57 |
| VII. Profit after Tax | -2.31 | -1.63 | -0.88 | -0.44 | 0.65 | 1.73 | 1.75 | 1.79 | 3.01 | 3.06 | 3.12 | 4.79 | 4.77 | 4.77 |
| VIII. Stock Dividend | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.44 | 4.44 | 4.44 |
| IX Net Profit/Deficit | **-2.31** | **-1.63** | **-0.88** | **-0.44** | **0.65** | **1.73** | **1.75** | **1.79** | **3.01** | **3.06** | **3.12** | **0.35** | **0.33** | **0.33** |
| 1. Balance for Previous Years at Beginning of the Year | 0.00 | -2.31 | -3.94 | -4.81 | -5.25 | -4.60 | -2.87 | -1.11 | 0.67 | 3.69 | 6.75 | 9.86 | 10.21 | 10.55 |
| 2. Balance of Accumulated Profit/Deficit at End of the ` | **-2.31** | **-3.94** | **-4.81** | **-5.25** | **-4.60** | **-2.87** | **-1.11** | **0.67** | **3.69** | **6.75** | **9.86** | **10.21** | **10.55** | **10.87** |

Note: 1. Overhead ratio (including taxes) 10% of Water and Sewerage Costs <== including taxes and duties
2. Ratio of bad account receivable 5% of Water Supply and Sewerage Service
3. Corporate Tax 35% of Profit of the Year

## Table A127.1.25 (1/3) Profit and Loss Table of West Water and Sewerage Company (Case 2): 2012-2038 (2/2)

(Unit: Rs. Billion)

| Item | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I. Operating Revenue | **20.51** | **20.51** | **20.51** | **23.44** | **23.44** | **23.44** | **26.81** | **26.81** | **26.81** | **30.69** | **30.69** | **30.69** | **35.14** |
| 1. Water Sales | 13.95 | 13.95 | 13.95 | 16.04 | 16.04 | 16.04 | 18.45 | 18.45 | 18.45 | 21.22 | 21.22 | 21.22 | 24.40 |
| (1) Domestic | 10.14 | 10.14 | 10.14 | 11.66 | 11.66 | 11.66 | 13.41 | 13.41 | 13.41 | 15.42 | 15.42 | 15.42 | 17.74 |
| (2) Non-domestic | 3.81 | 3.81 | 3.81 | 4.38 | 4.38 | 4.38 | 5.04 | 5.04 | 5.04 | 5.79 | 5.79 | 5.79 | 6.66 |
| 2. Sewerage Service | 6.56 | 6.56 | 6.56 | 7.40 | 7.40 | 7.40 | 8.36 | 8.36 | 8.36 | 9.47 | 9.47 | 9.47 | 10.74 |
| (1) Domestic | 4.06 | 4.06 | 4.06 | 4.67 | 4.67 | 4.67 | 5.36 | 5.36 | 5.36 | 6.17 | 6.17 | 6.17 | 7.09 |
| (2) Non-domestic | 1.52 | 1.52 | 1.52 | 1.75 | 1.75 | 1.75 | 2.01 | 2.01 | 2.01 | 2.32 | 2.32 | 2.32 | 2.66 |
| (3) Sewage Receiving | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |
| II. Operating Expenses | 9.53 | 9.25 | 9.31 | 9.31 | 9.32 | 9.53 | 9.32 | 9.55 | 9.80 | 10.05 | 10.32 | 10.57 | 10.83 |
| 1. Operation Costs | 7.63 | 7.40 | 7.45 | 7.45 | 7.46 | 7.62 | 7.45 | 7.64 | 7.84 | 8.04 | 8.26 | 8.46 | 8.67 |
| (1) Water Supply | 6.50 | 6.27 | 6.30 | 6.37 | 6.40 | 6.42 | 6.27 | 6.43 | 6.60 | 6.78 | 6.96 | 7.13 | 7.31 |
| 1) Electricity | 0.96 | 1.01 | 1.05 | 1.10 | 1.15 | 1.20 | 1.25 | 1.31 | 1.37 | 1.43 | 1.49 | 1.56 | 1.63 |
| 2) Compensation | 0.05 | 0.05 | 0.05 | 0.05 | 0.06 | 0.06 | 0.06 | 0.06 | 0.07 | 0.07 | 0.07 | 0.07 | 0.08 |
| 3) Water Source Cost | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 | 2.36 |
| 4) Depreciation | 2.40 | 2.12 | 2.08 | 2.08 | 2.04 | 1.98 | 1.75 | 1.83 | 1.91 | 2.00 | 2.09 | 2.15 | 2.22 |
| 5) Others | 0.72 | 0.74 | 0.75 | 0.77 | 0.79 | 0.82 | 0.84 | 0.87 | 0.89 | 0.92 | 0.95 | 0.99 | 1.02 |
| (2) Sewerage | 1.13 | 1.13 | 1.15 | 1.08 | 1.06 | 1.20 | 1.18 | 1.21 | 1.23 | 1.26 | 1.29 | 1.32 | 1.35 |
| 1) Electricity | 0.06 | 0.07 | 0.07 | 0.07 | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.09 | 0.10 | 0.10 | 0.11 |
| 2) Compensation | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.06 | 0.06 | 0.06 | 0.06 | 0.07 | 0.07 | 0.07 |
| 3) Depreciation | 0.69 | 0.67 | 0.68 | 0.58 | 0.54 | 0.66 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 |
| 4) Others | 0.33 | 0.34 | 0.36 | 0.37 | 0.39 | 0.40 | 0.42 | 0.44 | 0.46 | 0.48 | 0.50 | 0.52 | 0.55 |
| 2. Others | 1.91 | 1.85 | 1.86 | 1.86 | 1.86 | 1.91 | 1.86 | 1.91 | 1.96 | 2.01 | 2.06 | 2.11 | 2.17 |
| III. Net Operating Revenue/Deficit | **10.98** | **11.26** | **11.20** | **14.13** | **14.12** | **13.91** | **17.50** | **17.26** | **17.01** | **20.63** | **20.37** | **20.12** | **24.31** |
| IV. Non-operating Profit/Loss | -1.31 | -1.22 | -1.11 | -1.12 | -0.96 | -0.86 | -0.93 | -0.72 | -0.49 | -0.45 | -0.18 | 0.13 | 0.22 |
| 1. Non-operating Income | 1.39 | 1.39 | 1.41 | 1.45 | 1.52 | 1.52 | 1.52 | 1.64 | 1.78 | 1.91 | 2.09 | 2.30 | 2.53 |
| (1) Interest Revenue | 1.39 | 1.39 | 1.41 | 1.45 | 1.52 | 1.52 | 1.52 | 1.64 | 1.78 | 1.91 | 2.09 | 2.30 | 2.53 |
| (2) Other Revenues | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. Non-operating Expenses | 2.71 | 2.61 | 2.52 | 2.57 | 2.48 | 2.38 | 2.46 | 2.36 | 2.27 | 2.37 | 2.27 | 2.18 | 2.31 |
| (1) Long-term Interest (New Loans) | 1.73 | 1.64 | 1.54 | 1.45 | 1.35 | 1.26 | 1.17 | 1.07 | 0.98 | 0.88 | 0.79 | 0.69 | 0.60 |
| (2) Short-term Interest | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (3) Bad Debt Expense | 0.98 | 0.98 | 0.98 | 1.12 | 1.12 | 1.12 | 1.29 | 1.29 | 1.29 | 1.49 | 1.49 | 1.49 | 1.71 |
| V. Ordinary Profit/Loss | 9.67 | 10.04 | 10.10 | 13.01 | 13.16 | 13.05 | 16.56 | 16.54 | 16.52 | 20.18 | 20.19 | 20.24 | 24.53 |
| VI. Profit Tax | 3.38 | 3.51 | 3.53 | 4.55 | 4.61 | 4.57 | 5.80 | 5.79 | 5.78 | 7.06 | 7.07 | 7.08 | 8.59 |
| VII. Profit after Tax | 6.28 | 6.53 | 6.56 | 8.45 | 8.56 | 8.49 | 10.76 | 10.75 | 10.74 | 13.11 | 13.12 | 13.16 | 15.95 |
| VIII. Stock Dividend | 4.44 | 4.44 | 4.44 | 4.44 | 4.44 | 4.44 | 4.44 | 4.44 | 4.44 | 4.44 | 4.44 | 4.44 | 4.44 |
| IX Net Profit/Deficit | **1.84** | **2.09** | **2.12** | **4.01** | **4.12** | **4.05** | **6.32** | **6.31** | **6.30** | **8.67** | **8.68** | **8.72** | **11.51** |
| 1. Balance for Previous Years at Beginning of the Year | 10.87 | 12.72 | 14.80 | 16.93 | 20.94 | 25.06 | 29.10 | 35.43 | 41.74 | 48.04 | 56.71 | 65.40 | 74.11 |
| 2. Balance of Accumulated Profit/Deficit at End of the Year | **12.72** | **14.80** | **16.93** | **20.94** | **25.06** | **29.10** | **35.43** | **41.74** | **48.04** | **56.71** | **65.40** | **74.11** | **85.62** |

## Table A127.1.25 (2/3) Cash Flow Table of West Water and Sewerage Company (Case 2): 2012-2038 (1/2)

(Unit: Rs. Billion)

| Item | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **I. Procurement** | | | | | | | | | | | | | | |
| 1. Operating Revenue | 2.76 | 3.67 | 5.37 | 7.48 | 10.15 | 12.84 | 12.84 | 12.84 | 14.77 | 14.77 | 14.77 | 16.98 | 16.98 | 16.98 |
| 2. Sewage Receiving | 0.80 | 0.85 | 0.89 | 0.94 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |
| 3. Depreciation | 1.88 | 2.13 | 2.49 | 3.17 | 3.46 | 3.26 | 3.27 | 3.28 | 3.28 | 3.29 | 3.30 | 3.00 | 3.01 | 3.02 |
| 4. Account Receivable*1 | -0.45 | -0.15 | -0.28 | -0.35 | -0.44 | -0.44 | 0.00 | 0.00 | -0.32 | 0.00 | 0.00 | -0.36 | 0.00 | 0.00 |
| 5. Interest Revenue from Saving | 0.00 | 0.41 | 0.33 | 0.44 | 0.40 | 0.39 | 0.50 | 0.63 | 0.77 | 0.93 | 1.10 | 1.26 | 1.31 | 1.36 |
| Gross Internal Cash Position | 4.99 | 6.90 | 8.81 | 11.68 | 14.55 | 17.03 | 17.60 | 17.74 | 19.49 | 19.97 | 20.15 | 21.86 | 22.28 | 22.34 |
| 1. Capital Infusion | 14.00 | | | | | | | | | | | | | |
| 2. Existing Facilities Taken Over | 12.15 | | | | | | | | | | | | | |
| 3. Donation of Existing Facilities | 18.25 | | | | | | | | | | | | | |
| 4. Foreign Loan (Existing) | 6.00 | | | | | | | | | | | | | |
| 5. Foreign Loan (New Loans) | 8.60 | 6.10 | 3.80 | 12.70 | 13.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6. Government Assistance | 0.00 | | | | | | | | | | | | | |
| 7. Short-term Borrowing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total Sources | 63.99 | 13.00 | 12.61 | 24.38 | 27.75 | 17.03 | 17.60 | 17.74 | 19.49 | 19.97 | 20.15 | 21.86 | 22.28 | 22.34 |
| **II. Disbursement** | | | | | | | | | | | | | | |
| 1. Investment | 41.15 | | | | | | | | | | | | | |
| (1) Existing Facilities Taken Over | 12.15 | | | | | | | | | | | | | |
| (2) Donation from KW&SB | 18.25 | | | | | | | | | | | | | |
| (3) Water Supply Facilities | 8.43 | 5.81 | 3.06 | 6.65 | 6.85 | | | | | | | | | |
| (4) Sewerage Facilities | 2.32 | 1.77 | 1.72 | 9.28 | 9.68 | | | | | | | | | |
| (5) Replacement of Water Supply | | | | | | 0.16 | 0.16 | 0.16 | 0.17 | 0.17 | 0.17 | 0.17 | 0.21 | 0.22 |
| (6) Replacement of Sewerage | | | | | | | | | | | | | | |
| 2. Debt Services | 1.13 | 1.31 | 1.44 | 2.03 | 2.57 | 2.46 | 2.44 | 2.42 | 2.41 | 2.39 | 2.80 | 3.07 | 3.21 | 3.79 |
| (1) Principal Repayment (Transferred) | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| (2) Principal Repayment (New Loans) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.43 | 0.74 | 0.93 | 1.56 |
| (3) Financial Charges (Transferred) | 0.30 | 0.24 | 0.22 | 0.20 | 0.19 | 0.17 | 0.15 | 0.14 | 0.12 | 0.10 | 0.09 | 0.07 | 0.05 | 0.03 |
| (4) Financial Charges (New Loans) | 0.43 | 0.67 | 0.81 | 1.42 | 1.99 | 1.89 | 1.89 | 1.89 | 1.89 | 1.89 | 1.89 | 1.87 | 1.84 | 1.80 |
| 3. Debt Services for Short Financing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (1) Principal Repayment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Financial Charges | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 4. Deferred Assets | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5. Inventory Stock*2 | 0.19 | 0.17 | 0.20 | 0.24 | 0.25 | 0.25 | 0.26 | 0.26 | 0.27 | 0.28 | 0.28 | 0.29 | 0.30 | 0.31 |
| 6. Other Disbursement | 3.41 | 3.57 | 3.89 | 4.35 | 4.57 | 5.75 | 5.83 | 5.90 | 5.97 | 6.05 | 6.13 | 6.14 | 6.23 | 6.32 |
| 7. Profit Tax | 0.00 | 0.00 | 0.00 | 0.00 | 0.35 | 0.93 | 0.94 | 0.96 | 1.62 | 1.65 | 1.68 | 2.58 | 2.57 | 2.57 |
| Total Disbursement | 46.88 | 5.05 | 5.53 | 6.61 | 7.74 | 9.39 | 9.47 | 9.55 | 10.27 | 10.36 | 10.89 | 12.08 | 12.31 | 12.99 |
| **III. Net Cash Flow** | **17.11** | **7.95** | **7.08** | **17.78** | **20.01** | **7.64** | **8.12** | **8.19** | **9.22** | **9.60** | **9.25** | **9.78** | **9.97** | **9.36** |
| **IV. Opening Cash Balance** | 0.00 | 17.11 | 25.06 | 32.14 | 49.91 | 69.92 | 77.56 | 85.69 | 93.87 | 103.09 | 112.69 | 121.95 | 131.73 | 141.70 |
| **V. Accumulated Cash Position** | **17.11** | **25.06** | **32.14** | **49.91** | **69.92** | **77.56** | **85.69** | **93.87** | **103.09** | **112.69** | **121.95** | **131.73** | **141.70** | **151.06** |

Note: *1 Turnover of account receivable was assumed at 6.1
*2 Inventory Stock ws assumed as 30% of annual consumption.

## Table A127.1.25 (2/3) Cash Flow Table of West Water and Sewerage Company (Case 2): 2012-2038 (2/2)

(Unit: Rs. Billion)

| Item | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **I. Procurement** | | | | | | | | | | | | | |
| 1. Operating Revenue | 19.53 | 19.53 | 19.53 | 22.46 | 22.46 | 22.46 | 25.83 | 25.83 | 25.83 | 29.70 | 29.70 | 29.70 | 34.16 |
| 2. Sewage Receiving | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |
| 3. Depreciation | 3.10 | 2.79 | 2.75 | 2.67 | 2.58 | 2.65 | 2.38 | 2.45 | 2.54 | 2.62 | 2.71 | 2.78 | 2.85 |
| 4. Account Receivable*1 | -0.42 | 0.00 | 0.00 | -0.48 | 0.00 | 0.00 | -0.55 | 0.00 | 0.00 | -0.64 | 0.00 | 0.00 | -0.73 |
| 5. Interest Revenue from Saving | 1.39 | 1.39 | 1.41 | 1.45 | 1.52 | 1.52 | 1.52 | 1.64 | 1.78 | 1.91 | 2.09 | 2.30 | 2.53 |
| Gross Internal Cash Position | 24.59 | 24.69 | 24.68 | 27.08 | 27.54 | 27.61 | 30.16 | 30.91 | 31.13 | 34.59 | 35.49 | 35.77 | 39.79 |
| 1. Capital Infusion | | | | | | | | | | | | | |
| 2. Existing Facilities Taken Over | | | | | | | | | | | | | |
| 3. Donation of Existing Facilities | | | | | | | | | | | | | |
| 4. Foreign Loan (Existing) | | | | | | | | | | | | | |
| 5. Foreign Loan (New Loans) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6. Government Assistance | | | | | | | | | | | | | |
| 7. Short-term Borrowing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total Sources | 24.59 | 24.69 | 24.68 | 27.08 | 27.54 | 27.61 | 30.16 | 30.91 | 31.13 | 34.59 | 35.49 | 35.77 | 39.79 |
| **II. Disbursement** | | | | | | | | | | | | | |
| 1. Investment | | | | | | | | | | | | | |
| (1) Existing Facilities Taken Over | | | | | | | | | | | | | |
| (2) Donation from KW&SB | | | | | | | | | | | | | |
| (3) Water Supply Facilities | | | | | | | | | | | | | |
| (4) Sewerage Facilities | | | | | | | | | | | | | |
| (5) Replacement of Water Supply | 1.85 | 1.36 | 1.38 | 1.42 | 1.54 | 1.58 | 1.76 | 1.95 | 2.07 | 2.14 | 2.11 | 1.70 | 1.72 |
| (6) Replacement of Sewerage | | 0.12 | 0.12 | 0.01 | 2.81 | 2.86 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. Debt Services | 4.37 | 3.86 | 3.76 | 3.67 | 3.57 | 3.48 | 3.39 | 3.29 | 3.20 | 3.10 | 3.01 | 2.91 | 2.82 |
| (1) Principal Repayment (Transferred) | 0.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Principal Repayment (New Loans) | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 | 2.22 |
| (3) Financial Charges (Transferred) | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (4) Financial Charges (New Loans) | 1.73 | 1.64 | 1.54 | 1.45 | 1.35 | 1.26 | 1.17 | 1.07 | 0.98 | 0.88 | 0.79 | 0.69 | 0.60 |
| 3. Debt Services for Short Financing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (1) Principal Repayment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Financial Charges | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 4. Deferred Assets | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5. Inventory Stock*2 | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 | 0.37 | 0.38 | 0.39 | 0.41 | 0.42 | 0.44 | 0.45 | 0.47 |
| 6. Other Disbursement | 6.44 | 6.46 | 6.56 | 6.65 | 6.74 | 6.88 | 6.94 | 7.10 | 7.26 | 7.43 | 7.61 | 7.79 | 7.99 |
| 7. Profit Tax | 3.38 | 3.51 | 3.53 | 4.55 | 4.61 | 4.57 | 5.80 | 5.79 | 5.78 | 7.06 | 7.07 | 7.08 | 8.59 |
| Total Disbursement | 14.50 | 14.16 | 14.19 | 15.21 | 15.28 | 15.29 | 16.50 | 16.57 | 16.64 | 18.02 | 18.12 | 18.24 | 19.86 |
| **III. Net Cash Flow** | **10.08** | **10.54** | **10.50** | **11.87** | **12.27** | **12.32** | **13.66** | **14.34** | **14.48** | **16.57** | **17.37** | **17.52** | **19.92** |
| **IV. Opening Cash Balance** | 151.06 | 161.14 | 171.68 | 182.17 | 194.04 | 206.30 | 218.62 | 232.28 | 246.62 | 261.10 | 277.68 | 295.05 | 312.57 |
| **V. Accumulated Cash Position** | **161.14** | **171.68** | **182.17** | **194.04** | **206.30** | **218.62** | **232.28** | **246.62** | **261.10** | **277.68** | **295.05** | **312.57** | **332.49** |

## Table A127.1.25 (3/3) Balance Sheet of West Water and Sewerage Company (Case 2): 2012-2038 (1/2)

(Unit: Rs. Billion)

| Item | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **I. Assets** | **56.29** | **60.76** | **63.29** | **75.15** | **88.60** | **89.93** | **91.29** | **92.67** | **95.29** | **97.95** | **100.23** | **99.45** | **98.46** | **96.83** |
| 1. Fixed Assets | 41.58 | 48.80 | 47.00 | 59.92 | 73.15 | 70.05 | 66.94 | 63.82 | 60.71 | 57.58 | 54.46 | 51.63 | 48.83 | 46.03 |
| (1) Fixed Assets | 41.15 | 48.73 | 53.50 | 69.59 | 86.28 | 86.44 | 86.60 | 86.76 | 86.93 | 87.10 | 87.27 | 87.44 | 87.65 | 87.87 |
| (2) Accumulated Depreciation | -1.88 | -4.01 | -6.50 | -9.67 | -13.13 | -16.39 | -19.66 | -22.94 | -26.22 | -29.51 | -32.81 | -35.81 | -38.82 | -41.84 |
| (3) Works in Progress | 2.32 | 4.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. Current Assets | 14.71 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (1) Cash | 2.09 | 1.65 | 2.24 | 2.01 | 1.95 | 2.53 | 3.20 | 3.88 | 4.67 | 5.54 | 6.35 | 6.58 | 6.85 | 7.03 |
| (2) Bank Deposit | 11.84 | 9.35 | 12.70 | 11.38 | 11.08 | 14.36 | 18.14 | 21.96 | 26.48 | 31.39 | 35.99 | 37.31 | 38.84 | 39.83 |
| (3) Account Receivable | 0.45 | 0.60 | 0.88 | 1.23 | 1.66 | 2.11 | 2.11 | 2.11 | 2.42 | 2.42 | 2.42 | 2.78 | 2.78 | 2.78 |
| (4) Allowance for Doubtful Account | 0.14 | 0.18 | 0.27 | 0.37 | 0.51 | 0.64 | 0.64 | 0.64 | 0.74 | 0.74 | 0.74 | 0.85 | 0.85 | 0.85 |
| (5) Inventory Stock | 0.19 | 0.17 | 0.20 | 0.24 | 0.25 | 0.25 | 0.26 | 0.26 | 0.27 | 0.28 | 0.28 | 0.29 | 0.30 | 0.31 |
| (6) Other Assets | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **II. Equity and Liabilities** | **56.29** | **60.76** | **63.29** | **75.15** | **88.60** | **89.93** | **91.29** | **92.67** | **95.29** | **97.95** | **100.23** | **99.45** | **98.46** | **96.83** |
| 1. Long Term Liabilities | 14.20 | 20.30 | 23.70 | 36.00 | 48.80 | 48.40 | 48.00 | 47.60 | 47.20 | 46.80 | 45.97 | 44.84 | 43.51 | 41.55 |
| (1) Consumer Deposits | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Long Term Foreign Loans (Existing) | 5.60 | 5.60 | 5.20 | 4.80 | 4.40 | 4.00 | 3.60 | 3.20 | 2.80 | 2.40 | 2.00 | 1.60 | 1.20 | 0.80 |
| (3) Long Term Foreign Loans (New) | 8.60 | 14.70 | 18.50 | 31.20 | 44.40 | 44.40 | 44.40 | 44.40 | 44.40 | 44.40 | 43.97 | 43.24 | 42.31 | 40.75 |
| 2. Current Liabilities | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (1) Short-term borrowing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Contractor Deposit | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3. Equity | 42.09 | 40.46 | 39.59 | 39.15 | 39.80 | 41.53 | 43.29 | 45.07 | 48.09 | 51.15 | 54.26 | 54.61 | 54.95 | 55.28 |
| (1) Equity | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 |
| (2) Equity (Donation of Existing Facilities) | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 |
| (3) Profit/Loss for the Year | -2.31 | -3.94 | -4.81 | -5.25 | -4.60 | -2.87 | -1.11 | 0.67 | 3.69 | 6.75 | 9.86 | 10.21 | 10.55 | 10.87 |
| (4) Grant in Aid (for Capital Works) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Note *1 Turnover of account receivable was assumed at 6.1

*2 Inventory Stock ws assumed as 30% of annual consumption.

## Table A127.1.25 (3/3) Balance Sheet of West Water and Sewerage Company (Case 2): 2012-2038 (2/2)

(Unit: Rs. Billion)

| Item | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **I. Assets** | **96.05** | **95.52** | **95.42** | **97.21** | **99.11** | **100.93** | **105.04** | **109.13** | **113.21** | **119.66** | **126.13** | **132.62** | **141.91** |
| 1. Fixed Assets | 44.78 | 43.48 | 42.23 | 40.99 | 42.77 | 44.56 | 43.94 | 43.44 | 42.97 | 42.48 | 41.88 | 40.80 | 39.68 |
| (1) Fixed Assets | 89.72 | 91.20 | 92.71 | 94.14 | 98.50 | 102.94 | 104.70 | 106.65 | 108.71 | 110.85 | 112.96 | 114.66 | 116.38 |
| (2) Accumulated Depreciation | -44.94 | -47.73 | -50.48 | -53.15 | -55.73 | -58.38 | -60.75 | -63.21 | -65.75 | -68.37 | -71.08 | -73.86 | -76.70 |
| (3) Works in Progress | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. Current Assets | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (1) Cash | 7.02 | 7.13 | 7.30 | 7.66 | 7.68 | 7.68 | 8.28 | 8.97 | 9.65 | 10.56 | 11.62 | 12.75 | 14.17 |
| (2) Bank Deposit | 39.76 | 40.41 | 41.38 | 43.41 | 43.50 | 43.52 | 46.91 | 50.81 | 54.67 | 59.85 | 65.84 | 72.26 | 80.28 |
| (3) Account Receivable | 3.20 | 3.20 | 3.20 | 3.68 | 3.68 | 3.68 | 4.23 | 4.23 | 4.23 | 4.87 | 4.87 | 4.87 | 5.60 |
| (4) Allowance for Doubtful Account | 0.98 | 0.98 | 0.98 | 1.12 | 1.12 | 1.12 | 1.29 | 1.29 | 1.29 | 1.49 | 1.49 | 1.49 | 1.71 |
| (5) Inventory Stock | 0.31 | 0.32 | 0.33 | 0.34 | 0.35 | 0.37 | 0.38 | 0.39 | 0.41 | 0.42 | 0.44 | 0.45 | 0.47 |
| (6) Other Assets | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **II. Equity and Liabilities** | **96.05** | **95.52** | **95.42** | **97.21** | **99.11** | **100.93** | **105.04** | **109.13** | **113.21** | **119.66** | **126.13** | **132.62** | **141.91** |
| 1. Long Term Liabilities | 38.93 | 36.31 | 34.09 | 31.87 | 29.65 | 27.43 | 25.21 | 22.99 | 20.77 | 18.55 | 16.33 | 14.11 | 11.89 |
| (1) Consumer Deposits | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Long Term Foreign Loans (Existing) | 0.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (3) Long Term Foreign Loans (New) | 38.53 | 36.31 | 34.09 | 31.87 | 29.65 | 27.43 | 25.21 | 22.99 | 20.77 | 18.55 | 16.33 | 14.11 | 11.89 |
| 2. Current Liabilities | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (1) Short-term borrowing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| (2) Contractor Deposit | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3. Equity | 57.12 | 59.21 | 61.33 | 65.34 | 69.46 | 73.50 | 79.83 | 86.14 | 92.44 | 101.11 | 109.80 | 118.51 | 130.02 |
| (1) Equity | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 |
| (2) Equity (Donation of Existing Facilities) | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 | 30.40 |
| (3) Profit/Loss for the Year | 12.72 | 14.80 | 16.93 | 20.94 | 25.06 | 29.10 | 35.43 | 41.74 | 48.04 | 56.71 | 65.40 | 74.11 | 85.62 |
| (4) Grant in Aid (for Capital Works) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |